THE PLANT DISEASE REPORTER

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PLANT DISEASE EPIDEMICS
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IDENTIFICATION SECTION

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The Plant Disease Reporter is issued as a service to plant pathologists throughout the United States. It contains reports, summaries, observations, and comments submitted voluntarily by qualified observers. These reports often are in the form of suggestions, queries, and opinions, frequently purely tentative, offered for consideration or discussion rather than as matters of established fact. In accepting and publishing this material the Plant Disease Epidemics and Identification Section serves merely as an informational clearing house. It does not assume responsibility for the subject matter.

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PLANT DISEASE EPIDEMICS AND IDENTIFICATION SECTION

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IN THIS ISSUE

Virus Diseases: R. C. DICKSON'S list of the names applied to aphid vectors should be useful to workers with plant viruses, page 445. C. L. SCHNEIDER'S report of occurrence of sugar beet curly top in Minnesota and Iowa in 1954 adds to evidence indicating eastward spread of the vector and the virus, page 453. HARVEY W. RANKIN reports that development of internal cork symptoms in sweetpotatoes is apparently correlated with size of the roots, page 455. W. G. BENEDICT describes a ring spot virus disease that has been causing damage to red clover in Ontario, page 457. The barley stripe-mosaic virus is seed-borne in wheat, according to experimental results reported by F. H. McNEAL and M. M. AFANASIEV, page 460.

S. M. PADY and C. O. JOHNSTON report investigations on the epidemiology of wheat rusts in Kansas in 1954, page 463.

Weather and Plant Disease: JOHN H. OWEN discusses influence of weather on incidence of some plant diseases in a Florida location in the first part of 1955, page 467. Temperature, moisture, and soil type influence development of Sclerotinia sclerotiorum on vegetable crops in southern Florida, according to observations reported by W. D. MOORE, page 470. R. A. HYRE'S microclimatological study showed a considerable differential between relative humidity records taken among lima bean plants and 5 feet above, whereas temperature differences were slight, page 473.

The number and kind of micro-organisms obtained from pea seed are influenced by disinfectant and by medium employed for culturing, according to M. G. BOYER, page 475.

Potato smut is ordinarily considered a high altitude disease in Peru, but CONSUELO BAZÁN De SEGURA and ALFONSO QUEVEDO DÍAZ report occurrence in a coastal location, page 477.

R. S. COX describes a disorder of cucumber fruits apparently related to a certain type of cold injury and therefore called "cold pox", page 478.

Antibiotics (See also BOYER above and FERGUS et al below): D. F. CROSSAN and L. R. KRUPKA, page 480, discuss the manner in which streptomycin controls bacterial spot of pepper. R. S. COX reports more effective control of celery bacterial blight from a combination of Agrimycin and neutral copper than from either material used alone, page 484. Results of an evaluation of the sensitivity of a number of bacterial plant pathogens to several antibiotics and antibacterial substances are reported by B. S. MORGAN and R. N. GOODMAN, page 487.

Oak Wilt: Of several chemicals tested by C. L. FERGUS et al., Actidione was most toxic to the oak wilt fungus, page 494. T. W. BRETZ reports widespread susceptibility in the oak family, page 495. In experiments reported by T. W. JONES and T. W. BRETZ, page 498, oak wilt was not transmitted by tools that had been used on diseased trees.

Radioactive tracer studies on translocation past bark lesions in western white pine are reported by co-workers of the late ERNEST E. HUBERT, page 500.

JOSEPH M. OGAWA et al. report that almond scab in California is similar to peach scab but seems different in some respects, page 504.

Avocados in southern California are very susceptible to attack by Dematophora root rot, according to ROBERT D. RAABE and GEORGE A. ZENTMYER, page 509.

C. E. DALLIMORE describes equipment that increases efficacy of soil fumigation for nematode eradication, page 511.

ANNA E. JENKINS lists additional distribution for some spot anthracnoses, page 516.

CLARENCE M. LOCKE and ALICE J. WATSON report quarantine interceptions of some rusts and smuts of grasses, page 518.

Unusual Records, page 519: Clitocybe root rot on Camellia, and Camellia petal blight in Louisiana in 1955, both by A. G. PLAKIDAS; Alfalfa disease survey in Virginia, by S. B. FENNE.

April weather, page 521.

Preparation of manuscripts for the Reporter, page 522.

Vol. 39, No. 6--PLANT DISEASE REPORTER--June 15, 1955

A WORKING LIST OF THE NAMES OF APHID VECTORS

R. C. Dickson

In recent years the number of scientific names used for aphids has increased so greatly that people not specifically interested in aphid taxonomy have often been more confused than enlightened by them. This has come about partly through nomenclatorial uncertainties and partly through differing opinions as to the optimum size for a genus. American workers, led by Miriam A. Palmer, have generally favored large genera while European experts have favored splitting the aphids into a great number of small genera.

The following list has been compiled to aid workers in the field of the insect transmission of plant viruses. An attempt has been made to list every scientific name that has been used in reports and reviews in that field. Most of the aphid species listed have been reported to transmit one or more plant viruses but some names are included that have been listed only as non-vectors.

The names are listed alphabetically and crossed-indexed. Names in capitals are in the form used by Miriam A. Palmer (7) or are similar. Numbers referring to these names are starred. Names not capitalized and not underlined are primarily those preferred by Kurt Heinze (5) or by Carl Börner (2) and presumably are close to current European preference. Underlined names are in neither above category but many of them are in common use. American workers will generally find Miss Palmer's "Aphids of the Rocky Mountain Region" to be the most readily available and useful aid in aphid identification.

The lists below are not all strictly taxonomic, but are set up to aid the general worker in this field determine which species is actually meant by a name. For instance, it is now generally agreed that the name "convolvuli Kalt." is actually a synonym of "persicae Sulz.", the green peach aphid, but "convolvuli Kalt." is here listed under Myzus solani Kalt. (or Aulacorthum pseudosolani (Theob.)), the foxglove aphid, since this latter species is the one that has been reported under the name Myzus convolvuli (Kalt.).

As one example of how to use this list take the green peach aphid, Myzus persicae (Sulz.) or Myzodes persicae (Sulz.). The former name is preferred by the great majority of entomologists in America, but the latter name is preferred in Europe. These names are listed below as:

254. Myzodes persicae (Sulz.) *266 and
*266. MYZUS PERSICAE (Sulz.) 254.

If a worker comes to the name Myzodes persicae (Sulz.), he may refer to this name alphabetically in the list below and there note that it is preferred in Europe (not capitalized or underlined) and that no. *266 is the name preferred in the United States. Turning to no. *266 he sees the familiar Myzus persicae (Sulz.).

A slightly more complex example is no. *29, APHIS CARDUI L. Since this name is capitalized, it is the preferred American form. The two numbers following this name, 15, and 92, refer to 15, Anuraphis cardui (L.) and 92, Brachycaudus cardui (L.) the European preference. So it is seen that all three names refer to the same insect.

A still more complex example is illustrated by no. 3, Acyrthosiphon onobrychis (B.d.F.) 4, 187, 198, *211. Since this name is neither capitalized nor underlined, it is shown as current European preference. Reference to the starred number (*211) gives the American preference, MACROSIPHUM PISI (Kalt.), readily recognized as the pea aphid. The other three numbers refer to three other names sometimes used for the pea aphid: 4. Acyrthosiphon pisum (Harris); 187. Illinoia pisi (Kalt.); and 198. Macrosiphum destructor Johnson. All five of these names are scattered through the literature and all refer to one species, the pea aphid.

Where no European preference is indicated, American and European preferences are for the same name, which is capitalized. A few European species, with which the author is completely unfamiliar, have been left without a preferred American name.

This list includes 344 names that have been applied to 137 species of aphids.

1. Acyrthosiphon geranicola H.R.L. 85, 202, *203, 224.
2. Acyrthosiphon kondoi S. & K.
3. Acyrthosiphon onobrychis (B.d.F.) 4, 187, 198, *211.
4. Acyrthosiphon pisum (Harris) 3, 187, 198, *211.
5. Acyrthosiphon porosum (Sand.) *267.

6. Ammiaphis sii (Koch) 175, 176, *316, 321.
*7. AMPHOROPHORA LACTUCAE (L.) 181.
*8. AMPHOROPHORA ROSSI (H. & F.) 272.
*9. AMPHOROPHORA RUBI (Kalt.) 273.
*10. AMPHOROPHORA RUBICOLA (Oestl.) 274.
*11. AMPHOROPHORA RUBICUMBERLANDI (Knowl. & Allen) 183.
*12. AMPHOROPHORA SENSORIATA Mason 275, 332.
*13. AMPHOROPHORA VACCINII Mason
*14. AMPHOROPHORA VICIAE (Kalt.) 236, 237, 329.
15. Anuraphis cardui (L.) *29, 92.
16. Anuraphis helichrysi (Kalt.) 19, *45, 60, 93, 309.
17. Anuraphis marutae (Oestl.) *54, 94, 346.
18. Anuraphis padi (L.) 61, 308, *323.
19. Anuraphis padi (L.) 16, *45, 60, 93, 309.
20. Anuraphis persicae-niger (Smith) *62, 95.
21. Anuraphis subterranea (Walk.) *77.
22. Anuraphis tulipae (B.d.F.) *80, 347.
*23. APHIS ABBREVIATA Patch 65, 78, 158, 228.
*24. APHIS AGERATOIDES Oestl. 139.
*25. APHIS APIGRAVEOLENS Essig 42, 140.
*26. APHIS APII Theob. 141.
*27. APHIS ARMORACIAE Cowen 56, 151.
*28. APHIS AVENAE Fabr. 336.
*29. APHIS CARDUI L. 15, 92.
*30. APHIS CITRICIDIS Kirkaldy 31, 79, 142, 278.
31. Aphis citricola v. d. Goot *30, 79, 142, 278.
*32. APHIS CRACCAE L. 288.
*33. APHIS CRACCIVORA Koch 289.
*34. APHIS CRATAEGIFOLIAE Fitch 330, 331, 345.
*35. APHIS DECEPTA H. & F. 143.
36. Aphis epilobii Kalt. *59, 154, 230.
*37. APHIS FABAE Scop. 68, 161, 166.
38. Aphis ferruginea-striata Essig *48, 344.
*39. APHIS FORBESI Weed 114, 144.
*40. APHIS GAMBIR (C. B.) 145, 163.
*41. APHIS GOSSYPII Glover 115, 146, 162.
42. Aphis graveolens Essig *25, 140.
*43. APHIS GROSSULARIAE Kalt. 225.
*44. APHIS HELIANTHI Monell 124.
*45. APHIS HELICHRYSI Kalt. 16, 19, 60, 93, 309.
*46. APHIS HERACLELLA Davis 125, 147.
*47. APHIS IDAEI v. d. Goot 148, 226.
*48. APHIS INCULTA Walker 38, 344.
49. Aphis laburni Kalt. 50, *55, 138, 149, 164, 290, 291.
50. Aphis leguminosae Theob. 49, *55, 138, 149, 164, 290, 291.
*51. APHIS LUTESCENS Monell 58, 116, 153.
52. Aphis maidis Fitch 305, *320.
*53. APHIS MALVAE Koch 150, 160.
*54. APHIS MARUTAE Oestlund 17, 94, 346.
*55. APHIS MEDICAGINIS Koch 49, 50, 138, 149, 164, 290, 291.
56. Aphis middletonii (Thos.) *27, 151.
*57. APHIS MORDWILKIANA Dobz. 152, 165, 227.
58. Aphis nerii B.d.F. *51, 116, 153.
*59. APHIS OENOTHERAE Oestl. 36, 154, 230.
60. Aphis padi L. 16, 19, *45, 93, 309.
61. Aphis padi L. 18, 308, *323.
*62. APHIS PERSICAE-NIGER Smith 20, 95.
*63. APHIS POMI De Geer 155, 229.
64. Aphis pruni Fabr. *177, 179, 180
65. Aphis rhamni B.d.F. *23, 78, 158, 228.

*66. APHIS RUBICOLA Oestl. 67, 156, 231.
67. Aphis rubiphila Patch *66, 156, 231.
68. Aphis rumicis L. *37, 161, 166.
*69. APHIS SACCHARI Zehntner 313.
*70. APHIS SAMBUCI L.
*71. APHIS SAMBUCIFOLIAE Fitch
*72. APHIS SCHNEIDERI (CB) 232.
*73. APHIS SETARIAE (Thos.) 110, 185.
*74. APHIS SPIRAECOLA Patch 157, 233.
*75. APHIS SPIREAE Oestl. 96.
*76. APHIS SPIREAE Schout. 234.
*77. APHIS SUBTERRANEA Walker 21.
78. Aphis symphyti Schr. *23, 65, 158, 228.
79. Aphis tavaresi Del G. *30, 31, 142, 278.
*80. APHIS TULIPAE B.d.F. 22, 347.
*81. APHIS URTICATA Fabr. 159, 235.
*82. APHIS VIBURNICOLA Gillette 117.
83. Arthromyzus tulipellus (Theob.) 256.
84. Aulacorthum circumflexum (Buckt.) *259, 276.
85. Aulacorthum geranii (Kalt.) 1, 202, *203, 224.
86. Aulacorthum pelargonii (Kalt.) *210.
87. Aulacorthum pseudosolani (Theob.) 90, 168, 208, 217, 260, 268, *269.
88. Aulacorthum purpurascens (Oestl.) *189, 212.
89. Aulacorthum scariolae (Nevsky) *216.
90. Aulacorthum solani (Kalt.) 87, 168, 208, 217, 260, 268, *269.
91. Aulacorthum vincae (Walk.) 169, *233.
92. Brachycaudus cardui (L.) 15, *29.
93. Brachycaudus helichrysi (Kalt.) 16, 19, *45, 60, 309.
94. Brachycaudus marutae (Oestl.) 17, *54, 346.
95. Brachycaudus persicaecola (Boisd.) 20, *62.
96. Brachycaudus spireae (Oestl.) *75.
97. Brachycolus atriplicis (L.) 172, *178, 334.
98. Brachycolus brassicae (L.) *99.
*99. BREVICORYNE BRASSICAE (L.) 98.
*100. CALAPHIS BETULELLA Walsh
*101. CAPITOPHORUS BRAGGI (Gillette) 102, 103.
102. Capitophorus carduinus (Walker) *101, 103.
103. Capitophorus flaveolus (Walker) *101, 102.
*104. CAPITOPHORUS FRAGAEFOLII (Ckll.) 105, 279, 285, 286.
105. Capitophorus fragariae (Theob.) *104, 279, 285, 286.
*106. CAPITOPHORUS MINOR (Forbes)
*107. CAPITOPHORUS RIBIS (L.) 126.
*108. CAPITOPHORUS TETRARHODUS (Walk.) 280, 287.
*109. CAROLINAIA CYPERI (v. d. G.)
110. Carolinaia setariae (Thos.) *73, 185.
*111. CAVARIELLA AEGOPODII (Scop.) 112.
112. Cavariella capreae (Fabr.) *111.
*113. CAVARIELLA PASTINACEAE (L.)
114. Cerosipha forbesi (Weed) *39, 144.
115. Cerosipha gossypii (Glover) *41, 146, 162.
116. Cerosipha nerii (B.d.F.) *51, 58, 153.
117. Ceruraphis viburnicola (Gillette) *82.
118. Chaitophorus quercicola (Monell) *173, 250.
*119. CHAITOPHORUS VIMINALIS Monell 301.
*120. CINARA PINI (L.)
121. Clavigerus salicis (L.) *302.
122. Coloradoa rufomaculata (Wilson) 312, *327.
123. Coloradoa tanacetina (Walk.) *328.
124. Comaphis helianthi (Monell) *44.
125. Comaphis heraclella (Davis) *46, 147.

126. Cryptomyzus ribis (L.) *107.
127. Cryptosiphon essigi CB 242, *243.
128. Dactynotus ambrosiae (Thos.) *196.
129. Dactynotus gravicornis (Patch) *205.
130. Dactynotus obscurus (Koch) *209.
131. Dactynotus rudbeckiae (Fitch) *214.
132. Dactynotus sonchi (L.) *219.
133. Dactynotus tanaceti (L.) 134, *221, 294.
134. Dactynotus tanaceticola (Kalt.) 133, *221, 294.
135. Dactynotus taraxaci (Kalt.) *222.
136. Delphinobium junackianum (Karsch) *319.
137. Diphorodon cannabis (Pass.) *295.
138. Doralida leguminosae (Theob.) 49, 50, *55, 149, 164, 290, 291.
139. Doralina ageratoides (Oestl.) *24.
140. Doralina apigraveolens (Essig) *25, 42.
141. Doralina apii (Theob.) *26.
142. Doralina citricida (Kirk.) *30, 31, 79, 278.
143. Doralina decepta (H. & F.) *35.
144. Doralina forbesi (Weed) *39, 114.
145. Doralina gambir (C.B) *40, 163.
146. Doralina gossypii (Glover) *41, 115, 162.
147. Doralina heraclella (Davis) *46, 125.
148. Doralina idaei (v. d. G.) *47, 226.
149. Doralina leguminosae (Theob.) 49, 50, *55, 138, 164, 290, 291.
150. Doralina malvae (Koch) *53, 160.
151. Doralina middletonii (Thos.) *27, 56.
152. Doralina mordwilkiana (Dobz.) *57, 165, 227.
153. Doralina nerii (B.d.F.) *51, 58, 116.
154. Doralina oenotherae (Oestl.) 36, *59, 230.
155. Doralina pomi (De Geer) *63, 229.
156. Doralina rubicola (Oestl.) *66, 67, 231.
157. Doralina spiraecola (Patch) *74, 233.
158. Doralina transiens (Walk.) *23, 65, 78, 228.
159. Doralina urticaria (Kalt.) *81, 235.
160. Doralina umbrella C.B. *53, 150.
161. Doralis fabae (Scop.) *37, 68, 166.
162. Doralis frangulae (Koch) *41, 115, 146.
163. Doralis gambir C.B. *40, 145.
164. Doralis laburni (Kalt.) 49, 50, *55, 138, 149, 290, 291.
165. Doralis ruborum C.B. *57, 152, 227.
166. Doralis rumicis (L.) *37, 68, 161.
*167. DREPANAPHIS ACERIFOLII (Thos.)
168. Dysaulacorthum pseudosolani (Theob.) 87, 90, 208, 217, 260, 268, *269.
169. Dysaulacorthum vincae (Walk.) *91, 223.
170. Eulachnis agilis (Kalt.) *171, 300.
*171. EULACHNIS RILEYI (Williams) 170, 300.
172. Hayhurstia atriplicis (L.) 97, *178, 334.
*173. HOPLOCHAITOPHORUS QUERCICOLA (Monell) 118, 250.
174. Hyadaphis foeniculi (Pass.) *318.
175. Hyadaphis mellifera (Hottes) 6, 176, *316, 321.
176. Hyadaphis sii (Koch) 6, 175, *316, 321.
*177. HYALOPTERUS ARUNDINIS (Fabr.) 64, 179, 180.
*178. HYALOPTERUS ATRIPLICIS (L.) 97, 172, 334.
179. Hyalopterus pruni (Fabr.) 64, *177, 180.
180. Hyalopterus pruni (Geoff.) 64, *177, 179.
181. Hyperomyzus lactucae (L.) *7.
182. Hyperomyzus monardae (Williams) *263, 264.
183. Hyperomyzus rubicumberlandi (Knowl. & Allen) *11.
184. Hyperomyzus staphylae (Koch) 255, *315.
185. Hysteroneura setariae (Thos.) *73, 110.
186. Idiopterus violae (Perg.) *241.

187. Illinoia pisi (Kalt.) 3, 4, 198, *211.
188. Illinoia solanifolii (Ashm.) 194, 200, 201, *218, 261.
*189. KAKIMIA PURPURASCENS (Oestl.) 88, 212.
190. Lipaphis pseudobrassicae (Davis) *325.
191. Macrosiphon dirhodum (Walker) *199, 239.
192. Macrosiphon granarium (Kirby) *204, 337.
193. Macrosiphon rosae (L.) *213.
194. Macrosiphon solanifolii (Ashm.) 188, 200, 201, *218, 261.
195. Macrosiphoniella sanborni (Gill.) *215, 303.
*196. MACROSIPHUM AMBROSIAE (Thos.) 128.
*197. MACROSIPHUM BARRI Essig 238.
198. Macrosiphum destructor (Johnson) 3, 4, 187, *211.
*199. MACROSIPHUM DIRHODUM (Walker) 191, 239.
200. Macrosiphum euphorbiae (Thos.) 188, 194, 201, *218, 261.
201. Macrosiphum gei (Koch) 188, 194, 200, *218, 261.
202. Macrosiphum geranicola (H. R. L.) 1, 85, *203, 224.
*203. MACROSIPHUM GERANII (Kalt.) 1, 85, 202, 224.
*204. MACROSIPHUM GRANARIUM (Kirby) 192, 337.
*205. MACROSIPHUM GRAVICORNIS Patch 129.
*206. MACROSIPHUM IMPATIENTICOLENS Patch
*207. MACROSIPHUM LILII Monell 338.
208. Macrosiphum matsumuraenum Hori 87, 90, 168, 217, 260, 268, *269.
*209. MACROSIPHUM OBSCURUS (Koch) 130.
*210. MACROSIPHUM PELARGONII (Kalt.) 86.
*211. MACROSIPHUM PISI (Kalt.) 3, 4, 187, 198.
212. Macrosiphum purpurascens (Oestl.) 88, *189.
*213. MACROSIPHUM ROSAE (L.) 193.
*214. MACROSIPHUM RUDBECKIAE (Fitch) 131.
*215. MACROSIPHUM SANBORNI Gill. 195, 303.
*216. MACROSIPHUM SCARIOLAE (Nevsky) 89.
217. Macrosiphum solani Kalt. 87, 90, 168, 208, 260, 268, *269.
*218. MACROSIPHUM SOLANIFOLII (Ashm). 188, 194, 200, 201, 261.
*219. MACROSIPHUM SONCHI (L.) 132.
*220. MACROSIPHUM TABACI Perg.
*221. MACROSIPHUM TANACETI (L.) 133, 134, 294.
*222. MACROSIPHUM TARAXACI (Kalt.) 135.
*223. MACROSIPHUM VINCAE (Walk.) 91, 169.
*224. Macrosiphum zerozalphum Knowl. 1, 85, 202, *203.
225. Medoralis grossulariae (Kalt.) *43.
226. Medoralis idaei (v. d. Goot) *47, 148.
227. Medoralis mordwilkiana (Dobz.) *57, 152, 165.
228. Medoralis nasturtii (Kalt.) *23, 65, 78, 158.
229. Medoralis pomi (De Geer) *63, 155.
230. Medoralis praeterita (Walk.) 36, *59, 154.
231. Medoralis rubicola (Oestl.) *66, 67, 156.
232. Medoralis schneideri (CB) *72.
233. Medoralis spiraecola (Patch) *74, 157.
234. Medoralis ulmariae (Schr.) *76.
235. Medoralis urticata (Fabr.) *81, 159.
236. Megoura viciae (Buckt.) *14, 237, 329.
237. Megoura viciae (Kalt.) *14, 236, 329.
238. Metopolophium barri (Essig) *197.
239. Metopolophium dirhodum (Walker) 191, *199.
*240. MICROMYZUS FORMOSANUS Taka.
*241. MICROMYZUS VIOLAE (Perg.) 186.
242. Microsiphon artemisiae (Gill.) 127, *243.
*243. MICROSIPHUM ARTEMISIAE (Gill.) 127, 242.
*244. MONELLIA CARYAE (Monell)
*245. MONELLIA CARYELLA (Fitch)
*246. MYZAPHIS ROSARUM (Kalt.)
*247. MYZOCALLIS ALHAMBRA Davidson

*248. MYZOCALLIS ASCLEPIADIS (Monell)
249. Myzocallis ononidis (Kalt.) *251, 340.
250. Myzocallis quercicola (Monell) 118, *173.
*251. MYZOCALLIS TRIFOLII (Monell) 249, 340.
252. Myzodes ascalonicus (Donc.) *257, 304.
253. Myzodes ligustri (Mosley) *262.
254. Myzodes persicae (Sulz.) *266.
255. Myzotoxoptera staphylae (Koch) 184, *315.
256. Myzotoxoptera tulipella (Theob.) 83.
*257. MYZUS ASCALONICUS Donc. 252, 304.
*258. MYZUS CERASI (Fabr.)
*259. MYZUS CIRCUMFLEXUS (Bucht.) 84, 276.
260. Myzus convolvuli (Kalt.) 87, 90, 168, 208, 217, 268, *269.
261. Myzus lactucae (Schr.) 188, 194, 200, 201, *218.
*262. MYZUS LIGUSTRI (Mosley) 253.
*263. MYZUS MONARDAE (Davis) 182, 264.
264. Myzus monardae (Williams) 182, *263.
*265. MYZUS ORNATUS Laing
*266. MYZUS PERSICAE (Sulz.) 254.
*267. MYZUS POROSUS Sand. 5
268. Myzus pseudosolani Theob. 87, 90, 168, 208, 217, 260, *269.
*269. MYZUS SOLANI (Kalt.) 87, 90, 168, 208, 217, 260, 268.
270. Nasonovia ribicola (Kalt.) 271.
271. Nasonovia ribis-nigri Mosley 270.
272. Nectarosiphon rossi (H. & F.) *8.
273. Nectarosiphon rubi (Kalt.) *9.
274. Nectarosiphon rubicola (Oestl.) *10.
275. Nectarosiphon sensoriata (Mason) *12, 332.
276. Neomyzus circumflexus (Buckt.) 84, *259.
277. Neothomasia populicola (Thos.) *293.
278. Paratoxoptera argentinensis Blanchard *30, 31, 79, 142.
279. Passerinia fragaefolii (Ckll.) *104, 105, 285, 286.
280. Passerinia tetrarhoda (Walk.) *108, 287.
*281. PEMPHIGUS BETAE Doane 283, 297.
*282. PEMPHIGUS BURSARIUS (L.)
283. Pemphigus lactucae Fitch *281, 297
*284. PENTALONIA NIGRONERVOSA Coq.
285. Pentatrichopus fragaefolii (Ckll.) *104, 105, 279, 286.
286. Pentatrichopus potentillae (Walk.) *104, 105, 279, 285.
287. Pentatrichopus tetrarhodus (Walk.) *108, 280.
288. Pergandeida craccae (L.) *32.
289. Pergandeida craccivora (Koch) *33.
290. Pergandeida leguminosae (Theob.) 49, 50, *55, 138, 149, 164, 291.
291. Pergandeida medicaginis (Koch) 49, 50, *55, 138, 149, 164, 290.
*292. PERIPHYLLUS NEGUNDINIS (Thos.)
*293. PERIPHYLLUS POPULICOLA (Thos.) 277.
294. Pharalis tanaceti (L.) 133, 134, *221.
*295. PHORODON CANNABIS (Pass.) 137.
*296. PHORODON HUMILI (Schr.)
297. Prociphilus betae (Doane) *281, 283.
*298. PROCIPHILUS CORRUGATANS (Sirrine) 339.
*299. PROCIPHILUS FRAXINIFOLII (Riley)
300. Protolachnus agilis (Kalt.) *170, 171.
301. Pseudomicrella viminalis (Monell) *119.
*302. PTEROCOMMA SALICIS (L.) 121.
303. Pyrethromyzus sanborni (Gill) 195, *215.
304. Rhopalomyzus ascalonicus (Donc.) 252, *257.
305. Rhopalosiphon maidis (Fitch) 52, *320.
306. Rhopalosiphon nymphaeae (L.) *322.
307. Rhopalosiphon oxycanthae (Schr.) 310, *317, 324.
308. Rhopalosiphon padi (L.) 18, 61, *323.

309. Rhopalosiphon padi (L.) 16, 19, *45, 60, 93.
310. Rhopalosiphon prunifoliae (Fitch) 307, *317, 324.
311. Rhopalosiphon rhois (Monell) *326.
312. Rhopalosiphon rufomaculatus (Wilson) 122, *327.
313. Rhopalosiphon sacchari (Zehnt.) *69.
*314. RHOPALOSIPHONINUS LATYSIPHON (David.)
*315. RHOPALOSIPHONINUS STAPHYLAE (Koch) 184, 255.
*316. RHOPALOSIPHUM CONII (David.) 6, 175, 176, 321.
*317. RHOPALOSIPHUM FITCHII (Sand.) 307, 310, 324.
*318. RHOPALOSIPHUM FOENICULI (Pass.) 174.
*319. RHOPALOSIPHUM JUNACKIANUM (Karsch) 136.
*320. RHOPALOSIPHUM MAIDIS (Fitch) 52, 305.
321. Rhopalosiphum melliferum Hottes 6, 175, 176, *316.
*322. RHOPALOSIPHUM NYMPHEAE (L.) 306.
*323. RHOPALOSIPHUM PADI (L.) 18, 61, 308.
324. Rhopalosiphum prunifoliae Fitch 307, 310, *317.
*325. RHOPALOSIPHUM PSEUDOBRASSICAE (Davis) 190.
*326. RHOPALOSIPHUM RHOIS Monell 311.
*327. RHOPALOSIPHUM RUFOMACULATUM (Wilson) 122, 312.
*328. RHOPALOSIPHUM TANACETINA (Walk.) 123.
329. Rhopalosiphum viciae (Kalt.) *14, 236, 237.
330. Sappaphis crataegifoliae (Fitch) *34, 331, 345.
331. Sappaphis malifoliae (Fitch) *34, 330, 345.
332. Sappaphis sensoriata (Mason) *12, 275.
333. Schizaphis graminum (Rond.) *343.
334. Semiaphis atriplicis (L.) 97, 172, *178.
*335. SIPHA FLAVA (Forbes)
336. Sitobium avenae (Fabr.) *28.
337. Sitobium granarium (Kirby) 192, *204.
338. Sitobium lilii (Monell) *207.
339. Stagonia corrugatans (Sirrine) *298.
340. Therioaphis trifolii (Monell) 249, *251.
*341. THRIPSAPHIS BALLI (Gillette)
*342. TOXOPTERA AURANTII (B.d.F.)
*343. TOXOPTERA GRAMINUM (Rond.) 333.
344. Yezabura inculta (Walk.) 38, *48.
345. Yezabura malifoliae (Fitch) *34, 330, 331.
346. Yezabura marutae (Oestl.) 17, *54, 94.
347. Yezabura tulipae (B.d.F.) 22, *80.

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INCIDENCE OF CURLY TOP OF SUGAR BEETS IN MINNESOTA AND IOWA IN 1954[1]

C. L. Schneider[2]

In September, 1953, a sugar beet plant with symptoms of the curly top virus disease was found in experimental plots on the Southern Experiment Station at Waseca, Minnesota. At about the same time, another sugar beet with curly top symptoms was found near Mason City, Iowa, by D. B. Ogden of the American Crystal Sugar Company. These plants were sent to N. J. Giddings, U. S. Sugar Plant Field Station, Riverside, California, who reported that both were infected with curly top virus (2). In 1954, Douglass (1) summarized the entomological information on the distribution in the United States of the beet leafhopper, Circulifer tenellus Bak. This report included the collections of the insect made in Illinois and the first observations of curly top at Waseca, Minnesota, and Mason City, Iowa, in 1953.

In the summer of 1954, sugar beets with curly top symptoms were observed in seven commercial fields in Sibley, McLeod, Renville, and Freeborne Counties in southern Minnesota. Occurrence in Steele and Faribault Counties in southern Minnesota and in Cerro Gordo County in northern Iowa was reported by H. K. Jewell of the American Crystal Sugar Company. At each location, relatively few diseased plants were found; in most cases only one or two. Sugar beets with curly top were also found in experimental plots in Ramsey and Waseca Counties in Minnesota.

In 1954, the sugar beets growing in the experimental plots at the Southern Experiment Station, Waseca, Minnesota, were examined for curly top periodically and all plants having symptoms were tagged. Symptoms were observed first on July 9 and continued to appear until the latter part of September. On October 12, the tagged plants were graded according to the severity of curly top, and these observations are presented in Table 1. In general, the plants most affected were those that first showed symptoms early in the season. Out of a total of about 15,000 plants critically examined, 52 showed definite symptoms of curly top.

The incidence of curly top and the vector in 1955 should indicate whether this is a transient situation or whether the disease and its vector may increase in this area.

Table 1. Incidence of curly top on sugar beets in experimental plots at the Southern Experiment Station, Waseca, Minnesota, in 1954: approximately 15,000 plants critically examined for the disease.

Symptoms	Number of plants
Light -- Few leaves curled, typical curly top protuberances present on veins	13
Moderate -- Most of the inner leaves curled	14
Severe -- All leaves curled, plant stunted and foliage yellowish. In some cases plant did not develop beyond 6-or 8-leaf stages.	20
Dead -- Plant died, apparently from curly top, after symptoms were observed.	5
Total	52

[1] Paper No. 3338, Scientific Journal Series, Minnesota Agricultural Experiment Station.

[2] Pathologist, Field Crops Research Branch.

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COOPERATIVE INVESTIGATIONS BETWEEN THE FIELD CROPS RESEARCH BRANCH, AGRICULTURAL RESEARCH SERVICE, U. S. DEPARTMENT OF AGRICULTURE, AND THE MINNESOTA AGRICULTURAL EXPERIMENT STATION, ST. PAUL, MINNESOTA

THE INFLUENCE OF SWEETPOTATO SIZE ON THE DEVELOPMENT OF INTERNAL CORK SYMPTOMS IN THE ROOTS

Harvey W. Rankin

The internal cork virus disease of sweetpotato was first recognized 11 years ago. Since then the disease has spread to such an extent that it is found throughout most of the sweetpotato-growing parts of the southern United States. Porto Rico, which has been the principal variety for many years, is considered as practically 100 percent infected in the Southeastern States.

In a sweetpotato breeding program some method of measuring comparative susceptibility or resistance to internal cork is needed. Nusbaum (4) and other investigators (5, 2) have proved that several varieties exhibit a high degree of resistance. Wilcox (6) and others (3, 2) have shown that storage temperatures of 75° to 85° F. are necessary for the development of maximum internal cork symptoms. Nusbaum (4) reported that early planted sweetpotatoes developed more internal cork symptoms in the roots than did those planted later, but did not determine why this should be so.

Experimental Results: From 1949 through 1952 seed sweetpotatoes were selected, all of which showed internal cork symptoms. These were bedded and the draws produced from them were transplanted into field rows. At harvest time the progeny from each plant was put in a bag and the contents of all bags were cured and stored under identical conditions at about 80° F. Internal cork determinations were made and scored for all the roots from each plant. All roots produced by these plants were expected to show symptoms, but this was not true. Out of several hundred plant progenies tested, in less than a dozen did all the roots in the hill show internal cork symptoms. Though no weight records were made, it appeared that the larger sweetpotatoes showed a higher percentage of infection as well as more severe symptoms than small ones.

To obtain further data, 6 bushels of field-graded No. 1 Porto Ricos were cured and stored under the same conditions. They were then graded into categories by weight as shown in Table 1. The amount of internal cork was scored according to Nusbaum's scale (4).

Table 1. Influence of weight on the expression of internal cork symptoms in sweetpotato roots.

Weight category (gms.)	Percent with internal cork					
	None	Trace	Medium	Severe	Very severe	Total
0-100	60	17	19	3	1	40
101-200	43	19	25	10	3	57
201-300	33	22	23	16	6	67
Over 300	18	24	31	22	5	82

Results as given in Table 1 support the observation of higher percentage infection and more severe symptoms of internal cork in large than in small sweetpotato roots, other factors being equal.

Conclusions: In comparing sweetpotato varieties for resistance to internal cork, material should be used that has been cured and stored under identical conditions and graded to a uniform size.

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A RING SPOT VIRUS IN RED CLOVER IN ONTARIO[1]

W. G. Benedict[2]

Abstract

Observations in 1954 in southwestern Ontario showed that some stands of red clover (Trifolium pratense L.) were seriously infected and damaged by a ring spot virus disease. Symptoms in naturally infected red clover and those induced in several nonleguminous and leguminous plants are described. Results of many greenhouse tests indicated that the causal agent is a strain of tobacco ring spot virus (Annulus tabaci Holmes).

Introduction

In 1933, a virus disease of red clover was described by Johnson (3) in Kentucky which resembled yellow ring spot of tobacco, but all attempts to transmit the disease in order to identify it were unsuccessful. Since that time red clover has been shown by Hanson and Hagedorn, 1952 (1), to be a reservoir of legume viruses in Wisconsin, but apparently no ring spot was found among the several viruses that were identified.

In September, 1954, a ring spot disease of red clover was found in several widely separated fields in Essex County, Ontario. The disease was most common in second-year stands of the clover and was well established at the time it was first observed. The importance of the disease, as shown by the fact that 75 to 90 percent of the plants were infected in some fields, prompted an investigation of the causal agent.

Symptomatology

Naturally infected red clover leaflets (Figs. 1, 2) showed small to large, circular to irregular, chlorotic to necrotic spots with well-defined black to necrotic borders and oak leaf patterns covering a part or all of the leaflets. The necrotic borders were often biconcentric and usually all mature leaves showed symptoms of the disease. Sometimes a yellowing of leaf tissue spread out beyond necrotic spots; later these leaves became mostly yellow to white and finally they withered and died. Elongate chlorotic to necrotic areas with black to necrotic borders developed on the petioles and stipules of the infected leaves. Plant vigor and leaf development were appreciably reduced and retarded by the virus infection. Under natural conditions in the autumn and under greenhouse conditions during the winter a pronounced symptom expression of the virus persisted.

Methods and Results

Various potential host plants were grown in the greenhouse where transmission tests were conducted with the virus. The air temperature was about 72° F and the daylight was supplemented by artificial illumination to prolong the light to 14 hours a day. All inoculations were made with expressed plant juice using 400-mesh carborundum and the finger rub method. One aphid transmission test was made. Proof of virus transmission to the inoculated host was made for the virus in question by subinoculation in cowpea plants.

Symptoms Induced in Nonleguminous Plants: In Nicotiana tabacum var. Harrow Velvet small, circular, chlorotic to necrotic spots, 1 to 4 mm. in diameter, appeared on inoculated leaves in 3 to 5 days and were followed in a few days by chlorotic to necrotic spots, 1 to 6 mm. in diameter, that coalesced but retained well-defined necrotic borders. Yellow halos spread out beyond the necrotic borders. Foliage was distorted and brittle, and plant growth was greatly retarded. Some plants recovered from the disease but others showed systemic necrosis and mosaic that later produced green blisters on chlorotic leaves.

In N. tabacum var. Samsun there appeared in inoculated leaves chlorotic spots, small to medium-sized, circular to irregular and some of oak leaf design, 1 to 10 mm. in diameter. The spots coalesced at their necrotic borders. In systemically infected leaves the patterns

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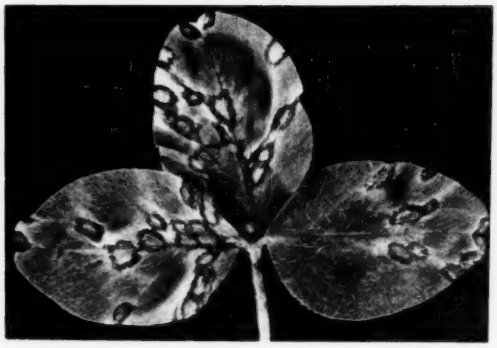

FIGURE 1. Red clover leaf showing necrotic ring spots and some yellowing of surrounding leaf tissue due to natural infection by the causal virus.

FIGURE 2. Red clover leaf showing oak leaf pattern of severe symptoms caused by the ring spot virus.

were similar, but chlorotic rings and patterns had well-defined necrotic borders that were often triconcentric and showed much coalescing. Chlorosis of tissue spread out beyond necrotic borders. Leaf mottle, distortion, crinkling and brittleness were present and plant growth was slightly retarded.

In N. glutinosa numerous necrotic spots appeared in 3 to 5 days; the inoculated leaves suffered severe shock and they soon withered and died. Other leaves were symptomless. In Vigna sinensis small to spreading red necrotic areas appeared in 2 to 3 days on the inoculated primary leaves. No systemic symptoms appeared. Inoculated leaves usually abscised and the plants soon died. In Chenopodium hybridum, the inoculated leaves showed small circular to irregular, red necrotic spots, a few of which were biconcentric and coalesced. A reddish zone extended considerably beyond the necrotic area. The virus was not systemic and did not retard plant growth appreciably in this host.

Symptoms Induced in Leguminous Plants: During the course of this investigation several undetermined viruses were isolated from red clover plants that displayed distinct ring spots and which were obtained from several fields. When the virus was transmitted in the greenhouse from one red clover plant to another, either by mechanical means, by aphids, or by grafting, the ring spot symptom itself did not appear. Some symptom of mosaic virus disease, however, was expressed. For example, a systemic necrotic, speckled and crinkled leaf disease was effected by mechanical transmission of the ring spot from red clover to another red clover plant but lucerne mosaic was recovered from this plant. In another instance, a systemic mottle appeared in a red clover plant after virus transmission by the common clover aphid which had fed on a red clover plant that showed ring spot symptoms. In this plant, growth was retarded and flower and seed development suppressed, but no virus symptom was obtained by subinoculation in cowpea. When T. hybridum and Medicago sativa were mechanically inoculated with the parent virus, a systemic vein mosaic appeared in one plant each but no virus was recovered by subinoculation in cowpea. No symptoms appeared in Melilotus officinalis and Pisum sativum when these plants were inoculated with the parent virus and again no virus was recovered by subinoculation in cowpea.

Characterization of the Virus: Thermal inactivation of the red clover ring spot virus took place at 68° C for 10 minutes. Low virus content of infected plants was apparent from dilution tests. Mechanical transmission was successful only when freshly expressed juice was used in a concentration of 1:1000 or higher. The addition of juice of healthy red clover to infective juice did not inhibit mechanical transmission of the virus to susceptible plants. Tobacco varieties Harrow Velvet and Samsun and Vigna sinensis inoculated with a known strain of tobacco ring spot virus did not show further symptoms when they were reinoculated with the red clover ring spot virus.

Discussion and Conclusion

The ring spot virus disease of red clover reported herein resembled that described by Johnson (3), but in the present investigation the virus was readily transmitted mechanically to tobacco and bean plants. Transmission of the virus under natural conditions is puzzling. In Ontario, infection of whole fields suggested that an efficient vector was at work, but such a vector was not found here or by previous investigators (2, 4, 5, 6). The prevalent clover mite or the clover root borer are worthy of investigation as possible transmitters of this virus. On red clover plants severely infected with ring spot virus in 1954, however, no trace of clover mite injury was found. Seed transmission, too, has not been demonstrated to account for an epiphytotic of red clover ring spot disease (3).

On the basis of host range, symptoms, temperature relations, physical properties, and plant protection tests the present studies suggest that the ring spot virus found in red clover in Ontario in 1954 is a strain of tobacco ring spot virus.

Acknowledgments

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TRANSMISSION OF BARLEY STRIPE MOSAIC THROUGH THE SEED IN 11 VARIETIES OF SPRING WHEAT[1]

F. H. McNeal and M. M. Afanasiev[2]

It has been shown by McKinney (4) and Eslick (1) that barley stripe mosaic (false-stripe) is seed-borne. McKinney (4) and Hagborg (2) reported that this disease also attacks wheat when the respective plants are inoculated.

Yield reductions of 31 percent in stripe mosaic-infected plants of Glacier barley have been reported by Eslick (1). Working with the same seed source of Glacier that Eslick used, McKinney (5) found that about 90 percent of the plants were diseased, despite the fact that many of the plants showed little or no virus symptoms. Hagborg (2) found a reduction in yield, kernel weight, and grade of grain from wheat plants that had been inoculated with barley stripe mosaic.

Results from the inoculation of spring wheat varieties with barley stripe mosaic are reported.

Materials and Methods

Eleven spring wheat varieties were planted in single 5-row plots of 5-foot rows spaced 12 inches apart at Bozeman, Montana, on May 10, 1954. Each plant in two of the five rows in each plot was inoculated with barley stripe mosaic on June 8 by use of the carborundum leaf wiping method (3). The inoculum was obtained from a composite of diseased Compana barley plants grown in the greenhouse. Readings for prevalence of the disease in each plant were made on July 17.

The plants from each inoculated row were pulled on August 30 and separated into two categories, one of normal appearing plants and the other of visibly stunted plants. The seed from each category from each row was kept separate.

Fifty seeds from the stunted plants of each row were planted in the greenhouse on November 24, 1954 to determine the percentage of seeds infected with barley stripe mosaic. Readings for mosaic were made on December 16 and 22, 1954. To obtain a correlation between readings in the field with readings in the greenhouse the two categories of seed were mixed and a second planting of 100 seeds from each row was made in the greenhouse on January 8, 1955. Readings for the presence of mosaic in this planting were made on January 27 and February 3, 1955.

Experimental Results

High percentages of infection of wheat with barley stripe mosaic were obtained in most of the rows of spring wheat inoculated in the field (Table 1). Lee and C.I. 13041 had the lowest readings of the 11 wheats studied. Rescue, C.I. 12974, Thatcher, Onas, Supreme, and C.I. 13042 had significantly higher percentages of diseased plants than did C.I. 13041.

There were some discrepancies between the percentages of disease obtained in the field and the percentages of seed-borne stripe mosaic obtained in two greenhouse plantings (Tables 1 and 2). A significant correlation coefficient of 0.515 was obtained between the percentages of diseased plants in the field and the percentage of diseased plants in the November greenhouse planting, while a highly significant correlation coefficient of 0.734 was obtained between the percentage of diseased plants in the field and the percentage of diseased plants in the January greenhouse planting. The November greenhouse planting had the highest percentage of diseased plants. A highly significant difference was obtained between the average percentage of disease in the two greenhouse plantings. This fact, plus evidence furnished by the correlation coefficients, indicates that some degree of success was achieved in visual separation of plants from the field into apparently diseased and disease-free categories.

C.I. 13041 had the lowest incidence of disease in both greenhouse plantings but there was some variation among the other varieties. Pilot, Selkirk, Lee, and C.I. 13041 had a higher percentage of diseased plants in the November greenhouse planting than they did in the field. However, the percentages obtained in the January greenhouse plantings were all lower than

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Table 1. Percentages of plants in 11 spring wheat varieties exhibiting barley stripe mosaic symptoms when inoculated in the field at Bozeman, Montana, on June 8, 1954.

Variety	Percent diseased plants		
	First row	Second row	Average
Rescue	92.9	96.0	94.4
C.I. 12974	100.0	78.6	89.3
Thatcher	93.8	76.5	85.2
Onas	80.0	76.9	78.4
Supreme	61.5	73.3	67.4
C.I. 13042	71.4	50.0	60.7
Pilot	76.5	23.1	49.8
Ceres	41.7	57.1	49.4
Selkirk	18.8	69.2	44.0
Lee	24.0	35.7	29.8
C.I. 13041	11.8	27.3	19.6

L.S.D. (P = .05) for variety averages = 40.3 percent

Table 2. Germination percentages and percentages of plants exhibiting barley stripe mosaic symptoms when 11 spring wheat varieties were planted in the greenhouse on November 24, 1954 and January 8, 1955.

Variety	Percent germination*			Percent diseased plants**		
	Nov.	Jan.	Average	Nov.	Jan.	Average
Rescue	97.0	94.5	95.8	73.2	56.1	64.6
Thatcher	88.0	93.5	90.8	81.8	46.5	64.2
Onas	88.0	85.0	86.5	61.4	50.0	55.7
Pilot	84.0	65.5	74.8	66.7	42.7	54.7
C.I. 13042	86.0	71.0	78.5	50.0	33.1	41.6
Selkirk	99.0	99.0	99.0	49.5	28.8	39.2
Lee	90.0	98.0	94.0	53.3	12.8	33.0
Supreme	91.0	82.5	86.8	26.4	31.1	35.8
C.I. 12974	91.0	74.0	82.5	39.6	22.3	31.0
Ceres	94.0	98.5	96.2	34.0	10.7	22.4
C.I. 13041	98.0	89.0	93.5	24.5	6.7	15.6
Average	91.5	86.4		50.9	31.4	

L.S.D. (P = .05) for variety averages = *12.3 and **22.8 percent
L.S.D. (P = .05) for planting averages = *N.S. and ** 9.7 percent

those from the respective field plantings.

There was no significant difference between germination percentages in the two greenhouse plantings. Neither was there a significant correlation between percentage of diseased plants in the field and observed germination in the greenhouse. The lowest germinations were obtained from Pilot and C.I. 13042.

Discussion

Many of the plants in rows inoculated in the field were stunted and some of the stunted plants produced heads that were completely sterile.

Yield determinations were not made, but it was obvious from the field plantings that more than 50 percent reduction in yield would have resulted in some varieties.

The reduction in vigor of the inoculated wheat plants seemed to be much more pronounced than that in nearby barley plants which had received the same source of inoculum. It seems possible that such loss in vigor, together with competition with other plants in large fields, would result in the death of infected plants. This might explain in part why barley stripe mosaic has not been identified in commercial wheat fields.

There appears to be no question but that this disease is seed-borne in wheat. Therefore, it is logical that certified seed stocks need examination for the presence of this virus.

Differential response to infection by barley stripe mosaic was indicated by some of the varieties used in this study. Further testing will be needed to establish the degree of tolerance.

Summary

Eleven spring wheat varieties were inoculated in the field by the carborundum leaf wiping method with barley stripe mosaic virus at Bozeman, Montana, in 1954. Seed from these inoculated plants was grown in greenhouse plantings and the plants were observed for presence of the disease.

High infection readings were obtained in the field and varietal differences were evident. Severe stunting and some sterility was observed in varieties with high percentages of mosaic.

Greenhouse plantings of seed from infected plants showed that barley stripe mosaic is seed-borne in wheat. Correlations of 0.515 and 0.734 were obtained between infection percentages in the field and in greenhouse plantings.

There was no apparent correlation between percentage of disease in the field and observed germination in the greenhouse. However, the germination of Pilot and C.I. 13042 was lower than normally would be expected.

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UNITED STATES DEPARTMENT OF AGRICULTURE AND MONTANA AGRICULTURAL EXPERIMENT STATION

THE CONCENTRATION OF AIRBORNE RUST SPORES IN RELATION TO EPIDEMIOLOGY OF WHEAT RUSTS IN KANSAS IN 1954[1]

S. M. Pady and C. O. Johnston[2]

Leaf and stem rusts of wheat have not been severe in Kansas since 1949. In 1953 stem rust approached epiphytotic proportions, and in 1954 a major epiphytotic was prevented only by hot dry weather. It seemed desirable to trace the development of the rust situation in 1954 with particular reference to daily concentration of rust spores in the air. This paper presents the results of this study and appropriate meteorological data.

There was a moderate quantity of leaf rust (Puccinia rubigo-vera f. sp. tritici) and light but widely scattered infections of stem rust (P. graminis f. sp. tritici) on volunteer and early-sown wheat in the western half of Kansas during the fall of 1953. The ensuing winter was very dry. Except for about 6 inches of snow in the eastern half on December 21 and 22 there was almost no effective moisture in most parts of the State. Low temperatures of -2° F on December 2 and -7° on January 22, effectively froze back top growth of wheat and all rust infection disappeared.

No spring rust infection on wheat was observed in the State until about May 1 when occasional uredia of leaf rust were observed in south-central counties. A few uredia of stem rust were observed in Sumner County May 5. Uredia of leaf rust were found at Manhattan May 6, with indications that infection had occurred at least 2 weeks earlier. There was, therefore, evidence that spores of both leaf rust and stem rust were blown into Kansas as early as April 15.

The period April 15 to May 15 was very dry except for light rains May 1 and 2. Temperatures during this period were too low for the rapid development of either wheat or rust. However, rust spores in considerable quantity were blown into the State during that period and primary infections were widely established. Stem rust spores seem to have arrived in the greatest concentration through Sumner, Harper, and Barber Counties and to have been disseminated in a northwesterly direction. The drought of April and early May delayed rust development. Conditions after May 15 were favorable for rapid rust development.

Beginning May 13, silicone-coated slides were exposed for 24-hour periods in a slide holder that kept the slide facing the wind at a 45° angle. The holder was mounted on the roof of Willard Hall in the center of the Kansas State College campus. The number of rust spores collected between May 14 and July 16 is recorded in Table 1, along with precipitation, temperature, wind, and other data. It is assumed that the leaf rust and stem rust urediniospores were those of leaf rust and stem rust of wheat. Spores of leaf rust of rye (P. rubigo-vera f. sp. secalis) and crown rust (P. coronata) of oats cannot be distinguished from spores of leaf rust of wheat, nor is stem rust of oats and barley distinguishable from that on wheat. While the rusts of rye, oats, and barley were present in the State, the acreages of the three crops were so small that it is assumed that spore numbers on the slides were negligible.

During May, leaf-rust spores were recorded on all but 2 days (Table 1). They occurred on days of south wind, and on the two negative days, May 17 and 19, the wind was from the north. From May 20 on, leaf rust spores increased steadily in the air. Meanwhile leaf rust was developing rapidly in the field, and locally secondary infections were present. During this period temperatures were moderate, being over 90° F on only 1 day, with frequent rains (total 4.48 inches for the month) which provided ideal conditions for rapid rust development.

During May, stem rust was rarely present on the slides, being found on only six, in low concentrations (Table 1). May 27 and over the weekend of May 29, there was a small but definite increase in numbers. Apparently there was sufficient inoculum so that, combined with favorable infection conditions, it was rather general over the State with higher concentration in the south-central counties.

June 1 stem rust reached 20,000 spores per square foot, and 1.9 inches of precipitation was recorded. Favorable conditions extended to (or through) June 2 with rain also on this date,

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Table 1. Numbers of leaf rust (LR) and stem rust (SR) spores from gravity slides exposed 24 hours. Manhattan, Kansas, 1954.

MONTH Day -- Date	Gravity no. spores per sq. ft.		Weather preceding 24 hrs.			Remarks
	LR	SR	Temp. (°F)	Prec. (inches)	Wind direction	
MAY						
Thurs. 13	480	240	77		S, SE	Scattered LR and SR primaries
Fri. 14	2,448	---	80		SE, SW	
Sat.-Sun. 15, 16	6,048	---	86, 76	.18	S, SW, SE	Germination 76%
Mon. 17	---	---	66	.23	N	
Tues. 18	4,992	---	76	.16	N	Germination 85%
Wed. 19	---	---	68		N	
Thurs. 20	720	---	73		S, SE, SW	
Fri. 21	33,984	1,056	86		S, SE	Germinating
Sat.-Sun. 22, 23	4,896	---	91, 82	.58	S, NE	
Mon. 24	672	---	68	.04	NE	LR secondaries in fields
Tues. 25	1,056	---	62		E, S	
Wed. 26	4,632	144	77	T	SE, variable	LR germination 76%
Thurs. 27	16,752	3,168	84	.87	S, NW	Some germination
Fri. 28	1,392	---	77	1.07	NW	LR and SR increasing
Sat.-Sun. 29, 30	53,760	10,272	74, 84	.21	E, SE	
Mon. 31	1,392	672	82	.23	SW, W, NW	
JUNE						
Tues. 1	3,840	20,976	73	1.91	Variable, NW	
Wed. 2	87,360	3,552	72	.10	NW	
Thurs. 3	9,152	---	66		NW, variable	LR and SR abundant. Some fields flowering
Fri. 4	24,096	1,392	73		SE, S	
Sat.-Sun. 5, 6	215,232	50,304	77	.13	SE, S, SW, NW	
Mon. 7	13,488	1,056	80		NW, S, W	
Tues. 8	167,654	137,088	91		S, SE	
Wed. 9	96,240	92,688	94		S, SW	
Thurs. 10	104,400	163,392	95	T	S	Rust being checked by high temperatures.
Fri. 11	107,616	239,040	95	1.37	S, E, variable	LR germination 58% SR germination 27%
Sat.-Sun. 12, 13	66,048	117,408	82, 88	.12	S, SE	
Mon. 14	---	---	85	.38	S, variable, S, SW	
Tues. 15	48	48	74	.51	NW	
Wed. 16	39,688	96,576	84		SE	
Thurs. 17	16,320	59,280	91		S	
Fri. 18	1,440	22,592	94		S	
Sat.-Sun. 19, 20	5,328	126,960	93		S	
Mon. 21	28,752	120,048	96		S, N	Local combining* began
Tues. 22	1,056	13,488	88		N, variable, SE	
Wed. 23	4,608	25,920	91		S	
Thurs. 24	3,552	64,992	100		S	
Fri. 25	---	20,108	102		S	
Sat.-Sun. 26, 27	3,888	40,848	101		S	
Mon. 28	96	15,600	97		S	
Tues. 29	6,048	112,224	99		S, N	
Wed. 30	2,352	45,692	93		NE, SE	
JULY						
Thurs. 1	2,688	35,952	95	.37	S	
Fri. 2	---	6,721	101		S	
Sat.-Sun.-Mon. (72 hrs.) 3, 4, 5	48	8,496	103, 101, 104		S, SE, SW	
Tues. 6	48	16,320	105	.09	S, NW	
Wed. 7	1,344	18,480	96		NE	
Thurs. 8	---	---	92		E	
Fri. 9	---	6,720	98	.12	SE	
Sat.-Sun. (48 hrs.) 10, 11	---	6,000	90		SE	
Mon. 12	1,008	1,680	114		S	
Tues. 13	---	96	107		SW	
Wed. 14	3,888	74,928	104		W, N, NE	
Thurs. 15	1,056	45,696	80	.99	N, NE	
Fri. 16	---	---	72	.04	E	

*With harvester-threshers.

Table 2. Numbers of leaf rust (LR) and stem rust (SR) spores from slides exposed in September and October, 1954. Manhattan, Kansas.

MONTH Day -- Date	Gravity no. spores per sq. ft. LR	Gravity no. spores per sq. ft. SR	Weather preceding 24 hrs. Temp. (°F)	Weather preceding 24 hrs. Prec. (inches)	Weather preceding 24 hrs. Wind direction	Remarks
SEPTEMBER						
Fri.-Sun. 10, 11, 12	--	--	79	-	N, S	Occasional local SR infection
Mon. 13	48	96	92	.03	SW, variable, N	
Wed. 15	--	--	88		S, E	
Thurs. 16	--	--	98		S	
Fri. 17	--	--	96		S	
Sat.-Sun. 18, 19	--	--	99, 94		S	
Mon. 20	--	4704	94		NW	
Tues. 21	--	--	72		NE, NW	
Wed. 22	--	--	81		S	
Thurs. 23	--	1008	89		S, SE, SW	
Fri. 24	--	672	87		W, NW, NE	
Sat.-Sun. 25, 26	--	--	90		N	
Mon. 27	--	--	93		S	Many SR primaries in central areas.
Tues. 28	--	1008	92	T	S	Some heavy infections on volunteer. LR rare.
Wed. 29	--	1008	92	T	Variable, NW	
Thurs. 30	--	--	71	.03	NW	
OCTOBER						
Fri. 1	--	--	79	.02	S	
Sat.-Sun. 2, 3	--	682	97	.06	S, NE	Germinating
Mon. 4	--	328	89	T	S, N	
Tues. 5	--	672	60	.03	NW	
Wed. 6	--	--	57		E, variable	
Thurs. 7	--	--	65		S, SW	
Fri. 8	--	--	85		SW	
Sat.-Sun. 9, 10	--	--	93		SW	
Mon. 11	--	--	74	1.37	E	
Tues. 12	--	--	78		N	
Wed. 13		6000	76		S, SW, NW	Germinating
Thurs. 14	--	1008	72	.12	NW	
Fri. 15	--	--	59		N	
Sat. 16	--	672	73		W, NW	

and leaf rust spores trapped were 87,000 spores per square foot. From May 22 to June 2 a total of 5.03 inches of rain fell, which, with favorable temperatures, provided ideal conditions for rapid rust development. Wheat in central Kansas then had rust in most fields and some of the wheat was flowering. Heavy leaf rust spore showers occurred between June 4 and 9 and stem rust readings were also heavy during this period. By this time rust in many fields had approached epidemic proportions.

Beginning June 8 maximum temperatures began to rise into the 90's and, except for a rainy period between June 10 and 15, remained in the 90's for 17 days and exceeded 100° on 3 days (June 24-26). This hot, dry period effectively checked the rust epidemic but caused some heat damage to the wheat crop. Harvesting began locally on June 21. The highest reading of leaf rust, 167,000 spores per square foot, was recorded June 8 at the beginning of this period. High readings were also reported the 2 succeeding days. From this point on, there was a fairly steady decline in the number of leaf rust spores on the slides. In the eastern half of the State leaf rust infection was heavy, while in the western half rust was moderate to severe except in the two western tiers of counties. In general, leaf rust infections were the heaviest that have been observed since 1949 and the loss from this rust is estimated at 2 percent for the State.

By June 2 it was evident that there would be a major stem rust epidemic in Kansas unless something unforeseen intervened. From June 8 to 11 stem rust spore showers occurred, with southerly winds and high temperatures. The peak spore load occurred June 11, but high temperatures undoubtedly checked further infections. From June 12 to 16, frequent showers and lower temperatures were favorable for rust development, but wheat in most fields was rapidly approaching maturity. The hot dry weather of the last half of June caused rapid drying of wheat tissues and prevented further rust development. During this period southerly winds daily carried high numbers of stem rust spores, presumably from late fields farther south. Although a major epidemic of stem rust was averted losses were heavy in many localities. It is estimated that for the State the loss was 2.5 percent of the wheat crop from stem rust.

In July there was a noticeable decline in numbers of both leaf and stem rust spores, with occasional days when no spores were present (Table 1). On July 14 and 15 fairly high numbers of stem rust spores and some leaf rust spores were recorded, with northerly winds. Presumably these spores were being carried southward from infected fields in Nebraska and the Dakotas.

In Table 2 slide readings from September 10 to October 16 are recorded. Only one slide, September 13, showed leaf rust, whereas stem rust was present on 12 days. It is significant that in most cases the stem rust spores were brought in by northerly winds, either from late spring wheat in the northern plains or from volunteer winter wheat. Some stem rust was present locally by mid-September. On October 1 volunteer and planted wheat fields were examined in central Kansas. Surprisingly, leaf rust was completely absent, while stem rust was found in volunteer wheat in some localities. The rust was in the third or fourth generation, which indicated that spore showers had occurred much earlier. August and September continued hot and dry and conditions were generally unfavorable for rust development.

Discussion

Spores of stem rust and leaf rust were carried into Kansas in large numbers in the early part of the 1954 crop season. The minor epidemic that resulted was checked by hot dry weather, which caused considerable crop injury itself. There is good evidence, also, that conditions were favorable during September for a southward movement of stem rust that resulted in small local outbreaks in volunteer wheat and moreover may have assisted in providing viable inoculum for the areas in southern Texas and Mexico where the rust overwinters.

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WEATHER AS RELATED TO PLANT DISEASE DEVELOPMENT IN THE GAINESVILLE AREA OF FLORIDA FROM JANUARY TO APRIL, 1955

John H. Owen

The unusual weather conditions which existed in the Gainesville area of Florida during the first 3 months of 1955 were unfavorable for plant disease development. It is during this period that some of the most important annually appearing diseases normally occur. Azalea flower-spot (Ovulinia azaleae Weiss) is considered to be endemic during February and March, late blight (Phytophthora infestans (Mont.) De By.) of potato and tomato is usually prevalent in Florida at this time, the young foliage, fruit, and stems produced by the spring flush of citrus are susceptible to scab (Elsinoë fawcetti Jenkins & Bitanc.), flowers and young stems and foliage of dogwood are subject to infection from spot-anthracnose (Elsinoë corni Jenkins & Bitanc.), young oak leaves are susceptible to oak leaf blister (Taphrina coerulescens (Mont. & Desm.) Tul.), and tobacco downy mildew (Peronospora tabacina Adam) is of common occurrence during this period. It was of interest to compare the importance and relationship of temperature and moisture to disease development for this 3-month period.

AZALEA FLOWER-SPOT: This disease has been present in the Gainesville area since about 1940 and has occurred every year since it was first reported. The fungus attacks only the corollas and is not known to affect any other part of the plant. It survives from season to season in the form of thin black sclerotia in the mulch below the azalea bushes. The germination of these sclerotia by the formation of small apothecia usually coincides with the blooming of the azaleas. Ascospores are released, and if conditions are favorable, cause primary infection of the flowers nearest to the ground. The lesions formed on the flowers are covered with the conidia of fungus and serve as centers of infection from which the spores are disseminated widely.

Azalea flower-spot usually occurs during the early part of the flowering season. Disease development is favored by cool temperatures, the cardinal temperatures being minimum 40°, optimum 65°, and maximum 80° F, and by moist conditions, such as foggy mornings and rain[1]. Periods of low rainfall and high temperatures tend to hold the disease in check.

Flower-spot has been extremely severe in some seasons and rather mild in others. In 1951 after a cold January in which there was much flower damage resulting from cold injury followed by a warm, dry period, the disease was at a minimum. In 1952, 1953, and 1954 flower loss due to flower-spot was very severe.

In 1954 azaleas began blooming during the latter part of January, with the first symptoms of flower-spot being noticed early in February. The rainfall during this period was rather light, with small amounts falling on January 17, 18, and 30; however, there was sufficient moisture during the early mornings to insure initial infection. The mean temperature for this period was 62° F (Fig. 1). The conditions for disease development during February and March were ideal. Rain was recorded on February 1, 8, 20, 21, and 25, and March 1, 3, 7, 14, 19, 20, and 29. As shown in Figure 1, these rainfalls were rather light but well spaced and favorable for a maximum production of conidia and for secondary infection of flowers which continued to open during this period. The temperatures during February and the first 2 weeks of March was also optimum for disease development. During the first 2 weeks of February, when a majority of the flowers were opening, the mean temperature was 55°, and never once did the maximum temperature go above 75° or the minimum below 38°. These weather conditions contributed greatly to rapid spread of the fungus, and resulted in a high percentage of flower infection. Flowers became heavily infected within 3 to 4 days after opening, so that the length of the flowering period was reduced to approximately half the normal time. Production of sclerotia was enormous, and there was a plentiful supply for the 1955 season.

Flower-spot was expected to be severe in 1955, but on the contrary, no symptoms were observed by the writer or coworkers until April 6, when a few flowers remaining on a single plant of a late blooming variety were noticed to be infected. The absence of the disease can be accounted for by the rather peculiar weather conditions that prevailed during the flowering period (Fig. 1). The winter of 1954-55 was continuously colder than in the preceding year for this area, and as a result the initial flowers were late in opening. Precipitation during the last week of January, just prior to the opening of the first blossoms, measured 2.75 inches, which

[1] Weiss, F. 1940. A flower-spot disease of cultivated azaleas. U. S. Dept. Agr. Circ. 556. 28 pp.

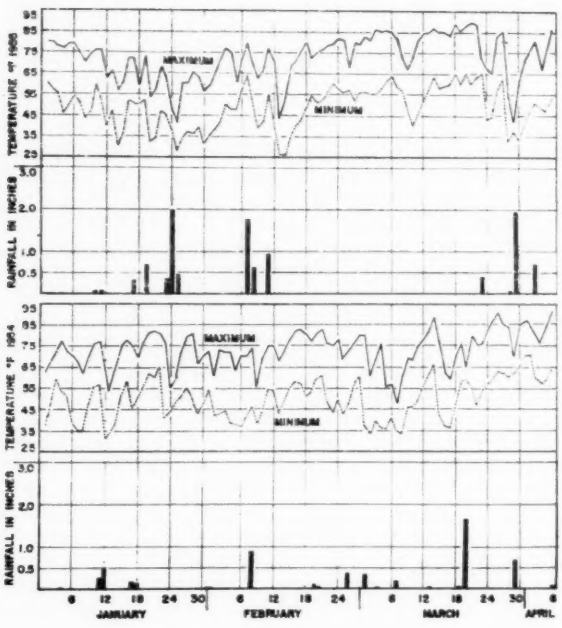

FIGURE 1. Daily minimum and maximum air temperatures and daily rainfall in the Gainesville area of Florida from January to April, 1954 and 1955.

was favorable for sclerotial germination and development of the apothecia. However, temperature was at a minimum level for the development of the fungus. The mean temperature for the period from January 23 to 31 was 46° F, with freezes on January 25 and 30. During the first week of February, when only a small percentage of the azalea plants were beginning to bloom, temperature was optimum and moisture sufficient for infection. A total of 3.26 inches of rain fell on the 7, 8, and 11 of February. This was followed by a sudden drop in temperature to 26°, with some localities reporting as low as 19°, thus killing a large percentage of the open flowers. If infection had taken place before the flowers were killed, it had not been observed. In the 40 days from February 12 until March 23 no rainfall was recorded, and the early mornings were extremely dry. The mean temperature for this period was 66°, and most of the time temperature was above the maximum for growth of the flower-spot fungus. The main flowering period came at this time, and by March 23 most of the flowers had shed normally. Rainfall on March 23, 27 and 29, followed by low temperatures, produced conditions favorable for infection of some of the late flowering plants. In extensive local surveys infections were found at only one location on April 6, and none thereafter.

It is of interest to note that the rainfall for the first 3 months of 1955 was much greater than for the same period in 1954 (10.12 to 6.12 inches); however, there was no rainfall while the flowers were most vulnerable to infection. Azaleas are one of the most widely used flowering ornamentals in this area, and practically every home has several to many plants. The severity of the flower-spot fungus determines whether or not the flowering season will be a success.

LATE BLIGHT OF POTATOES AND TOMATOES: Late blight on potatoes and tomatoes in Florida has been unusually mild this season. In many areas the disease was observed in only a few locations. In the Hastings area potato late blight was reported as being found on a few plants in one field. The high temperatures and insufficient moisture were unfavorable for the development of the late blight fungus.

CITRUS SCAB: This disease has not been observed on new growth in the Gainesville area or in unsprayed groves in Marion County so far in 1955. Optimum conditions for scab development are low temperatures combined with long periods of high humidity at a time when the young

growing tissues are susceptible. Moisture appears to be the limiting factor under Florida conditions. The temperature range for severe infection is 59° to 73° F[2]. The young tissues of susceptible species of citrus were susceptible from the middle of February until approximately the last of March. During this period there was no rain, and the temperature most of the time was above the optimum for development of the disease. Old scabby lesions from the previous season's growth were plentiful, but spore production on these lesions was at a minimum. In 1954 a high percentage of infection was observed on the young expanding foliage of susceptible hosts during the corresponding months.

DOGWOOD SPOT-ANTHRACNOSE: Trees that have been known to have spot-anthracnose every year for the past several seasons showed no signs of infection. The fungus lives from one season to the next in lesions on the twigs and infects the flowers, foliage and twigs when the new growth is developing. These tender, rapidly expanding tissues were susceptible during the unfavorable hot, dry period of February and March; therefore, little or no infection took place. During this same period in 1954 scab was abundant.

OAK LEAF BLISTER: The disease is endemic; however, during some seasons it might be sparse if hot, dry conditions are present at a time when the young foliage is susceptible to infection. During the 1954 season the disease was plentiful and conspicuous; as a matter of record, the young foliage on a wide range of oak species was found to be diseased. Where the disease was so abundantly present in previous years, none was found during the comparable period in 1955.

DOWNY MILDEW OF TOBACCO: Several early reports of downy mildew (blue mold) infection in tobacco seedbeds were made during the last week of January and the first week of February in 1955, at a time when conditions were conducive to the development of the disease. Continued observations were made by coworkers from February 11 until after April 7, when slight infections were again first seen in a few plant beds. Rainfall and low temperatures from March 24 to April 7 produced favorable conditions for its development during the latter part of the season.

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[2]Suit, R. F. 1949. Parasitic diseases of citrus in Florida. Florida Agr. Exp. Sta. Bul. 463.

RELATION OF RAINFALL AND TEMPERATURES TO THE INCIDENCE OF SCLEROTINIA SCLEROTIORUM IN VEGETABLES IN SOUTH FLORIDA DURING THE YEARS 1944 TO 1954

W. D. Moore[1]

In 1948 a report[2] was made on the effects of weather conditions on the incidence of sclerotiniose in vegetables in south Florida, but the data were for only four seasons and did not warrant definite conclusions. Since then yearly observations on disease incidence have been made and temperature and rainfall data have been compiled for a continuous period of 10 seasons. This paper presents the results.

Brooks[3] showed that maximum mycelial growth of Sclerotinia sclerotiorum takes place at 75° F and the minimum at 45°, and also that the sclerotia produced no apothecia at mean temperatures above 70° but produced them in 28 to 34 days below 70°. Previous disease records[2] indicate that sclerotiniose was worse during periods of high moisture and cool temperatures than during cool dry periods. From these reports it is apparent that temperature and moisture play important roles in the development of this disease in south Florida. Although the data presented in this paper suggest little of practical value on the control of sclerotiniose they add information on seasonal variations in temperatures and rainfall and their influence on the severity of sclerotiniose.

Temperature

Mean daily temperatures for approximately equal periods from December through February are tabulated in Table 1 for Homestead[4] and Pompano Beach, Florida, the readings for light disease years being separated from those for moderate to severe disease years. It is apparent that in most cases mean temperatures were lower at Homestead during seasons of moderate to severe disease than during seasons of light disease; however, at Pompano Beach temperatures were not materially different during the seasons of different disease intensity. It will be noted, however, that mean temperatures at both locations during all seasons were at 70° F or below from about the middle of December until the end of February. Since it is known that apothecia will form at these temperatures if given proper moisture and light, it seems reasonable to conclude that disease incidence at the two locations for the seasons shown was not limited by high temperatures.

Rainfall

Rainfall, together with its distribution, at the Homestead and at the Pompano Beach stations is given in Table 2 for seasons of light disease and of moderate to severe disease. At Pompano Beach rainfall was considerably higher during seasons of moderate to severe disease than during seasons of light disease except in December. The high December average resulted from heavy precipitation during a tropical storm in 1949 which was not repeated during the 10 years of these observations, hence this value is not representative. In addition, the number of days on which rain fell was considerably greater during moderate to severe disease seasons than during light disease seasons. These data indicate that moistures were fairly high during the seasons when sclerotiniose was moderate to severe in the Pompano Beach area.

While rainfall during moderate to severe disease seasons at Pompano Beach was appreciably heavier than during light disease seasons, this condition was not so clearly defined at Homestead. The data for Homestead show that precipitation was only slightly greater during moderate to severe disease seasons than during light disease seasons and that the numbers of days with rain were essentially the same. It should be noted, however, that the soils at Pompano Beach

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[1] Senior Pathologist, Horticultural Crops Research Branch, Agricultural Research Service, U. S. Department of Agriculture.

[2] Moore, W. D. 1948. Weather and the incidence of Sclerotinia sclerotiorum on vegetables in south Florida from 1944 to 1948. Plant Dis. Reptr. 32: 380-382.

[3] Brooks, A. N. 1940. Control of sclerotiniose on celery in Florida muck. Phytopath. 30: 703.

[4] Weather records for Homestead were provided by University of Florida Sub-Tropical Experiment Station, Homestead.

Table 1. Mean temperatures at Homestead and at Pompano Beach, Florida for 10-day periods for December, January, and February in seasons of light and of moderate to severe incidence of sclerotiniose, 1944-54.

Period	Mean temperatures (°F)			
	Homestead		Pompano Beach	
	Disease light	Disease moderate to severe	Disease light	Disease moderate to severe
Dec. 1-10	69.8	66.3	71.3	68.7
Dec. 11-20	71.2	63.0	70.2	64.6
Dec. 21-30	69.3	67.0	68.9	70.4
Dec. 31 - Jan. 10	66.4	66.3	66.8	68.8
Jan. 11-20	66.3	66.4	68.5	69.1
Jan. 21-30	69.6	66.0	69.8	68.4
Jan. 31 - Feb. 10	67.4	64.3	67.7	66.3
Feb. 10-20	69.1	66.8	70.1	68.6
Feb. 21-28	69.8	67.0	69.0	68.4

Table 2. Average rainfall and number of days with rain at Homestead and at Pompano Beach for December, January, and February in seasons when sclerotiniose was light and when it was moderately severe, 1944-54.

Month	Rainfall							
	Homestead				Pompano Beach			
	Disease light		Disease moderately severe		Disease light		Disease moderately severe	
	Rainfall (inches)	Days with rain	Rainfall (inches)	Days with rain	Rainfall (inches)	Days with rain	Rainfall (inches)	Days with rain
Dec.	0.80	7.7	1.40	6.5	2.30	5.8	1.79	5.8
Jan.	1.17	4.2	1.62	6.0	0.88	3.0	2.57	6.0
Feb.	1.26	5.5	1.80	5.1	1.15	3.0	1.75	6.0

are sandy and have a very low water-holding capacity, whereas those at Homestead are marl with a very high water-holding capacity. From this we may assume that, since the marl soils remain fairly moist at all times and the sandy soils vary greatly in moisture content, a smaller increase in rainfall would affect the overall moisture conditions on the marl soils more than would a larger amount on sandy soils.

Discussion

From the weather data presented it is apparent that mean daily temperatures in south Florida during December, January, and February were at optimum levels for the development of apothecia of Sclerotinia in all years of this study. Apparently the limiting factor for disease incidence was moisture, which may be influenced by soil type, crops grown, methods of culture, cloudiness, fogs, and dew formation, as well as by rainfall. Although the differences in rainfall between moderate to severe disease seasons and light disease seasons at Pompano Beach were greater than at Homestead, sclerotiniose was often more severe at the latter station. Apparently this was due in part to the wet marl soils, which were cool and induced heavy dews at night by chilling the warm moist air around the growing plants. Other factors which influenced high moisture in the marl soils were flat cultivation, which did not afford good soil drainage, and bushy crops, such as tomatoes, pole beans, and potatoes, which tended to hold excessive moisture during the late stages of growth. Disease incidence in plants on the sandy soils in the Pompano Beach area was for the most part associated directly with the amount of rain that fell during a given season.

The data collected indicate that while moisture was largely the limiting factor in the incidence of sclerotiniose in south Florida in December, January, and February, it was not the limiting factor in other months. Rainfall is often high in October and November, but sclerotiniose is not known to develop appreciably at this time of year, apparently because of the prevailing high mean temperatures, Likewise, disease incidence during March and April, when both low moisture and high mean temperatures are limiting factors, is extremely low. The few instances when sclerotiniose was found during these 2 months followed periods of below-normal mean temperatures.

When the December-February period is considered, it is of interest that sclerotiniose was of economic importance in the Homestead area in 6 out of 10 years of these observations and at Pompano Beach in 5 years. Thus, it is apparent that this disease, although it causes appreciable losses at infrequent intervals, is less important on vegetable crops in south Florida than other so-called major fungus diseases.

HORTICULTURAL CROPS RESEARCH BRANCH, AGRICULTURAL RESEARCH SERVICE,
U. S. DEPARTMENT OF AGRICULTURE

EFFECT OF LIMA BEAN COVER ON TEMPERATURE AND RELATIVE HUMIDITY

R. A. Hyre[1]

Summary

The differences in mean air temperature between four locations in or near Thorogreen bush lima bean plants was less than 1 1/2 °F. Recordings were made (a) among plants, (b) between rows, (c) in an instrument shelter located between two rows, and (d) 5 feet above ground over a row.

The mean relative humidity, by contrast, measured about 10 percent higher among plants than 5 feet above ground over a row.

The mean temperature for 22 days in a shelter between two rows was 0.7° F lower than that in a second shelter located about 450 feet away near farm buildings and 5 1/2 feet above ground.

The use of temperature and humidity data for forecasting downy mildew of lima bean (Phytophthora phaseoli) is being investigated. Thus, it becomes important to know the variation that is likely to occur between locations where such data may be collected.

On a clear windy day, Waggoner and Shaw[2] found the temperature 1 cm. beneath an upper exposed potato or tomato leaf to be about 1° C warmer than that in an instrument shelter located among the plants and about 1 1/4 feet above ground. On cloudy days, and on clear and cloudy nights, temperatures 1 cm. beneath an upper leaf were within 0.5° C of temperatures in the instrument shelter. Wallin and Shaw[3] found relatively little temperature differences in and over (up to 5 feet) tomato, potato, corn, and soybean foliage. The maximum difference was 2° F. However, the relative humidity varied considerably more, up to about 16 percent, in soybeans during the day. The night variations were much less.

In the present paper temperatures and relative humidities found among and near lima bean plants are recorded.

Materials and Methods

Temperatures and relative humidities in and near fully grown Thorogreen bush lima beans at University of Delaware Farm, Newark, were measured with a turbine-ventilated hand psychrometer. Psychrometric data were taken at 7:30 a.m., 1:30 p.m., and 7:30 p.m. Eastern Standard Time for a total of 28 days during September and early October (1953-54) at four locations within a few feet of each other. Three locations -- among the plants, between the 36-inch rows, and in a standard instrument shelter located between two rows -- were 6 inches above ground; the fourth location was 5 feet above ground and over a bean row.

In another study, daily maximum and minimum temperatures were recorded in the shelter among the bean plants, and in a second shelter about 450 feet away by the farm buildings and 5 1/2 feet above ground. The data were analyzed by the method of analysis of variance.

Results

The mean dry bulb temperatures and relative humidities for the four stations and the three daily readings are summarized in Table 1. The maximum mean temperature difference found between the four stations at any reading period was less than 1.5° F, although significant differences did exist.

The mean relative humidity among the plants in a row was always higher, and that five feet

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[1] Pathologist, Horticultural Crops Research Branch, Agricultural Research Service, United States Department of Agriculture.

[2] Waggoner, Paul E., and R. H. Shaw. 1952. Temperature of potato and tomato leaves. Plant Phys. 27: 710-724.

[3] Wallin, J. R., and R. H. Shaw. 1953. Studies of temperature and humidity at various levels in crop cover with special reference to plant disease development. Iowa State Coll. Jour. Sci. 28: 261-267.

Table 1. Mean temperature and relative humidity at several locations in Thorogreen bush lima beans at three times of day for 28 days. Newark, Delaware, September and early October, 1953-54.

Location	Level in feet	Temperature (°F)			Relative humidity (percent)		
		7:30 am	1:30 pm	7:30 pm	7:30 am	1:30 pm	7:30 pm
In a row	1/2	60.2	74.4	61.7	90.8	65.1	92.0
Between rows	1/2	60.2	74.4	61.9	88.3	62.7	90.0
In a shelter	1/2	59.3	73.7	63.0	89.1	60.3	87.0
Over a row	5	60.7	74.2	63.0	81.3	53.3	83.4
L.S.D. 5%		0.35			1.70		
L.S.D. 1%		0.47			2.25		

above ground over a row always lower, than that at any other location for the corresponding time of day. The humidity among the plants was 8 to 12 percent higher than 5 feet above ground. A difference of 2.25 percent was statistically significant at the 1 percent level.

The average of 22 daily mean temperatures in the shelter in the bean plot was 66.8° F compared to 67.5° in the shelter located 450 feet away at the farm buildings. The difference of 0.7° was just significant at the 5 percent level.

Discussion

The relatively small temperature differences of 1 or 2° F found between various locations in and near lima bean plants, or in an instrument shelter 450 feet away, would seem to be of little significance in the development of downy mildew. Therefore, for purposes of forecasting this disease temperature measurements need not be made among the plants, or even in their immediate vicinity.

If relative humidity records are used, however, they should be obtained among the plants, as a differential of about 10 percent exists between relative humidity among the plants and that 5 feet above ground over the plants.

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VARIATION IN THE INCIDENCE OF ASCOCHYTA PISI IN PEA SEED AS INFLUENCED BY TREATMENT AND MEDIA

M. G. Boyer

Summary

The examination of agricultural and commercial seeds for disease organisms usually involves the surface sterilization of seed in a disinfectant followed by plating out on a suitable agar medium. It appears that, in the case of peas infected with A. pisi, infection is to some extent influenced by the presence of other organisms, numerically or specifically, both of which are altered by the kind of media employed. The following experiment with peas illustrates how the incidence of disease organisms in seed may be altered by varying the conditions (media and treatment) under which the tests are carried out.

Procedure

A sample of peas known to be infected with A. pisi was tested in duplicate (100 pea seeds/sample) on four agar media -- malt, oatmeal, pea, and nutrient, adjusted to pH 6.5 --, as well as between germination blotters and in sand. In addition, two treatments were applied: (a) sterilization in 2% sodium hypochlorite for 15 minutes under partial vacuum, (b) washing in cold running tap water for 10 minutes. All samples were held at room temperature in an enclosed glass-topped seed germination tray and read at 12 days. Infection with A. pisi was based on the presence of pycnidia in the seed and on the media, or by re-isolation on pea agar from suspected cotyledonary lesions.

Results

Table 1 shows the total counts of fungi found on the different media. The germination blotter and sand tests could not be included in the total counts because of the great reduction in numbers of fungi.

Table 1. Variation in number of seed-borne fungi on germinating pea seed resulting from the use of different media and treatments.

Treatment	Replicate	Medium			
		Malt	Oatmeal	Pea	Nutrient
Chlorine	1	26	30	30	64
	2	29	30	26	65
Running water	1	140	124	90	32
	2	134	105	78	34

The number of fungi was greatly increased on nutrient agar when the seed was treated with chlorine. The marked decrease in numbers when the seed was treated with running water is probably due almost entirely to the increase in surface-borne bacteria in this medium over all other media. It also indicates the inhibitory effect exerted by bacteria under these conditions.

Table 2 illustrates how infected seedlings vary under the same conditions.

The significance of oatmeal agar over all other treatments is associated with its nutritional value as a substrate for Ascochyta pisi and its failure to promote bacterial growth.

Table 2. Variation in numbers of seedlings infected with Ascochyta pisi resulting from the use of different media and treatments.

Treatment	Replicate	Medium					
		Malt	Oatmeal	Pea	Nutrient	Blotter	Sand
Chlorine	1	4	8	7	4	5	5
	2	6	7	7	5	6	7
Running water	1	2	11	8	2	4	6
	2	3	9	6	1	4	5
Mean		3.75	8.75	7	3	4.75	5.75
L.S.D. 1%	1.63						

Discussion

Wallen and Skolko[1] first reported the presence of antibiotic substances on pea seed which inhibited Ascochyta pisi. Under these conditions, the antagonistic element appears to be predominantly bacterial since there are some grounds for assuming relationship between numbers of bacteria and the numbers of infected seedlings.

Since A. pisi is usually borne within the seed and sometimes deep within the cotyledons, it is doubtful that the surface flora could exert a direct effect on the initial development of the pathogen. Perhaps the effect is in depriving the disease organism of oxygen. Whatever the cause, in seed germinated in soil under laboratory conditions, this inhibitory effect was not evident.

Common media, acting selectively, apparently exert a marked influence on numbers and types of developing micro-organisms. This curtails the usefulness and scope of such a test, for while still applicable in a comparative sense, it bears little relationship to the actual numbers of disease organisms present. Under some circumstances, particularly where disease-free seed is essential and a determination of percentage infection is not required, a more sensitive method might include maceration of the seed followed by serial dilutions into a suitable agar medium.

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[1] Wallen, V. R., and A. J. Skolko. 1953. Inactivation of antifungal antibiotics by chlorine. Plant Dis. Reptr. 37: 421-424.

THE ANDEAN DISEASE OF POTATO TUBERS IN THE PERUVIAN COAST AREA

Consuelo Bazán de Segura and Alfonso Quevedo Díaz

In 1939, M. F. Barrus and A. S. Muller (4) found in the Andes Mountains of Venezuela a peculiar disease of potato tubers (Solanum tuberosum subsp. andigenum), known locally as "buba" disease. The affected tubers had warty swellings on the surface and were otherwise misshapen and sometimes cracked. Cross sections of diseased tubers revealed numerous brownish-black specks throughout the cortex to a depth of 1 cm. or more, which consisted of a dry, brown, powdery mass of spore balls.

Barrus observed the same disease on tubers from the Andes of Ecuador and Peru. He named the fungus involved Thecaphora solani (3).

Before the work of Barrus, the Andean disease of potato tubers was confused in Peru with powdery scab caused by Spongospora subterranea, because both were generally present in the same tubers grown in the fields of the "Sierra", producing important losses in some years.

The disease has been considered heretofore as being limited to the Andes at altitudes of 2500 to 3000 meters. However, during the past year heavily infected tubers of Solanum stoloniferum (D. G. V. 1018) were found in the lath-house of the Genetics Department of the Agricultural Experiment Station of La Molina, at an elevation of 251 meters (Fig. 1). The planting material was received from Wisconsin[2], United States of America, and immediately planted in the soil of the lath-house, among other potato varieties. None of the other varieties showed any signs of the disease at the time of harvest.

The question naturally arises as to whether Thecaphora solani is indigenous to the soils of the Peruvian Coast but is capable of producing the disease there only in very susceptible varieties under favorable environmental conditions. Experiments are under way to test this point with special attention to environmental conditions.

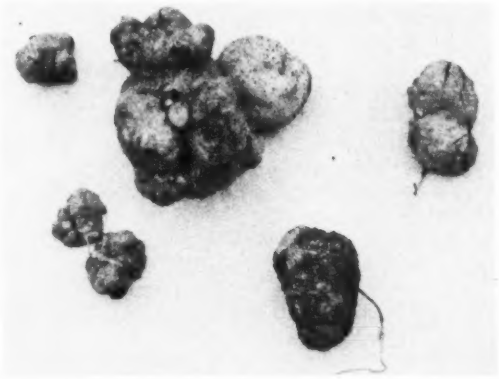

FIGURE 1. Tubers of Solanum stoloniferum attacked by the Andean disease of potatoes.

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4. _____, and A. S. Muller. 1943. An Andean disease of potato tubers. Phytopath. 33: 1086-1089.

[1]Respectively, Sub-chief of the Department of Plant Pathology, and Assistant in the Department of Genetics, La Molina Experiment Station, La Molina, Lima, Peru.

[2][Material under this number was originally collected in Mexico and imported as true seed which were grown at Sturgeons Bay, Wisconsin. Part of the resulting tubers were sent to the La Molina Station. Others have just been reexamined at the Plant Industry Station, Beltsville, Maryland, and found free of the fungus. --J. A. Stevenson]

COLD POX, A DISEASE ON CUCUMBER IN SOUTH FLORIDA

R. S. Cox

A sporadic disease of cucumber results in serious losses to growers in South Florida. It may develop at any time during the growing season, but appears to be especially prevalent during late fall (November and December) and again in late winter and early spring (February, March, and April).

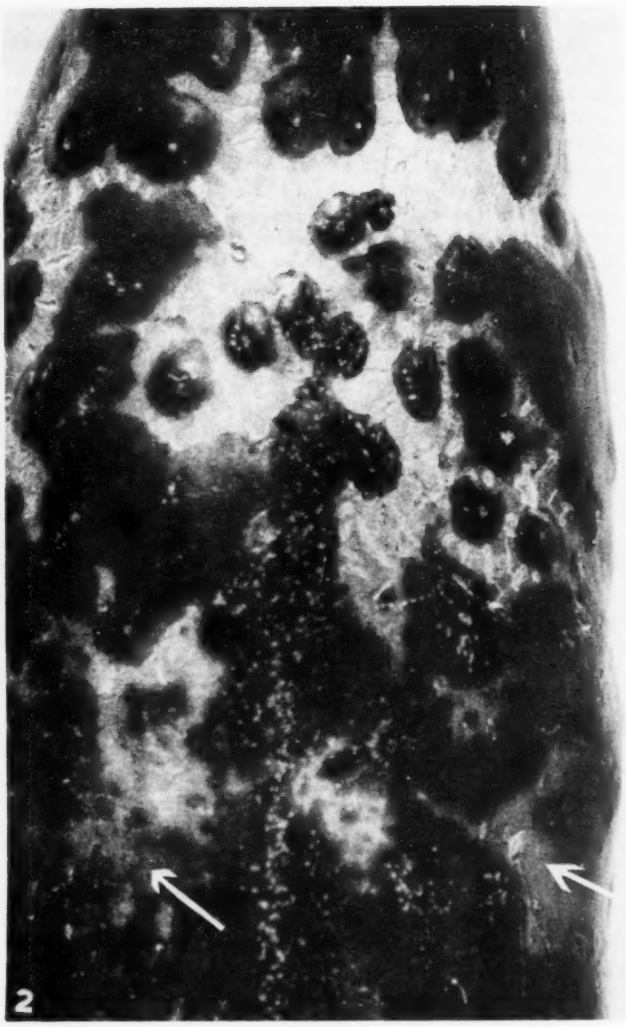

FIGURE 1. Cucumber fruit showing various stages of cold pox. FIGURE 2. Enlarged portion of Figure 1. Note early stages of cold pox symptoms (arrows). (Photographs by Henry M. Spelman, III).

As much as 75 percent of the total yield may be affected. Normally, however, the percentage falls within the range from 10 to 25. When the market is "weak" affected fruit are rejected; when the market is "strong" they are usually acceptable at a "marked down" grade. This means, of course, a reduced selling price for the grower.

Symptoms: Symptomatic expression of the disease appears to be restricted to the exposed surface of the fruit; other parts of the plant are not usually affected. In early stages the affected fruit exhibit symptoms in many respects similar to those produced by cucumber mosaic. Intermediate stages consist of blister-like areas of a light olivaceous color (Fig. 2). These areas gradually coalesce, and become dried and fissured in an irregular pattern with age (Figs. 1 and 2). Once this stage is reached no further progression of symptoms takes place even on fruit held in moist chambers.

Etiology: Dr. J. N. Simons was unable to transmit the disease by means of juice inoculations from affected fruit to seedlings, and concluded that it probably was not of virus origin. Neither was a pathogenic organism recovered from the diseased fruit. These results would possibly be expected in view of the fact that symptoms invariably occurred on only the exposed side of the fruit.

Repeated field observations suggested that the disease was the result of a sequence of variable weather conditions that always included a period of low temperature. Precise data are not available, but it appears that the minimum temperature necessary is above freezing.

Cold weather alone does not appear to account satisfactorily for the occurrence of the disease, however. Field observations indicate that it appears to be most serious, and generally first shows up, several days after the onset of a cold wet period immediately preceded by a relatively hot and dry period. After weather conditions become more favorable for cucumber growth the disease gradually disappears. Depending on the weather, this cycle may be repeated one or more times during a growing season.

Hunter[1] mentioned a similar disease occurring on cucumber during the past several seasons in the Plant City-Webster area. He raised the question as to whether it was a form of delayed cold injury. He mentioned a similar disease described in United States Department of Agriculture Poster #55 and Miscellaneous Publication 292 (both out of print), which was listed as low temperature breakdown. Walker[2] also described a disease of cucumber in storage and transit which he attributed to low temperature injury.

Unless subsequent work shows other factors than cold weather to be the causal agents, the name "cold pox" is suggested for the disease described here.

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[1] Hunter, W. P. 1954. Some crop abnormalities associated with weather conditions. Florida State Hort. Soc. Proc. 67: 111-115.

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THE USE OF STREPTOMYCIN ON PEPPER PLANTS FOR THE CONTROL OF XANTHOMONAS VESICATORIA[1]

D. F. Crossan and L. R. Krupka[2]

Summary

The data presented on Agrimycin-100 (15% streptomycin and 1.5% Terramycin) when used in spray solution at rates to give approximately 250 and 500 ppm streptomycin indicate that:

1. It is not detectable in the leaves of pepper plants but is detectable in the leaves of snap-bean plants, indicating a varying host response.
2. It does not eradicate the causal organism of bacterial leaf spot of pepper (Xanthomonas vesicatoria) from established leaf lesions when used at concentrations as high as 500 ppm.
3. Its action is that of a bacteriostatic protectant when used at concentrations of 250 ppm.
4. It will reduce infection of pepper leaves by X. vesicatoria when used at frequent intervals at concentrations of 250 ppm and higher.

Field observations made in Delaware in 1954 indicated that infection of pepper leaves by Xanthomonas vesicatoria could occur 11 days after plants had received applications of crude streptomycin and Agrimycin-100[3] at 500 ppm. Subsequent greenhouse and laboratory tests were conducted to determine whether or not a commercially available form of streptomycin when applied as a spray to pepper leaves became systemic, acted as a surface protectant, or eradicated the bacterium from established lesions.

The work of Mitchell et al. (4) showed that a streptomycin concentrate, applied in a lanolin paste to the stems of snap bean, would move into the stems and, subsequently, to the foliage. Pramer (5) has shown that certain plant species will absorb and translocate streptomycin when root systems are immersed in antibiotic-containing solutions. Cox et al. (1) have shown this to be true for pepper. However, with the exception of the work by Goodman (2), a survey of the literature did not reveal any investigations on the movement or action of streptomycin when applied as a foliage spray.

A preliminary report of the present study is in press (3). In the present greenhouse work Agrimycin-100 was used at concentrations of 250 and 500 ppm streptomycin and applied with a small electric power sprayer[4] at 45-50 lbs. pressure. Potted pepper plants (variety, California Wonder) in the 5 to 6 leaf stage of growth were used except where indicated.

Absorption and Translocation

A total of nine separate tests were performed using the following procedures: Pepper plants were sprayed with Agrimycin at a given concentration of material. Periodically, thereafter, 4 leaves were picked from a given plant at a given time. Two of the leaves were thoroughly washed in tap water; the remaining 2 were not washed. The washed and unwashed leaf samples were ground separately in mortars with the addition of approximately 1 ml. of sterile distilled water. The resulting expressed sap was not filtered. Absorbent filter-paper discs, 6 mm. in diameter, were then placed in the sap for 1 minute, drained to remove excess moisture, and then placed on the surface of nutrient agar plates seeded with X. vesicatoria. These plates were prepared by mixing the bacterial suspension and medium 1 hour prior to plating the discs.

In addition to the unfiltered sap from sprayed leaves, washed and unwashed, samples were taken from unsprayed leaves on separate plants to serve as controls. An antibiotic control was made by soaking filter paper discs in a given concentration of the antibiotic used and then placing

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[1] Published as Miscellaneous Paper No. 226 with the approval of the Director of the Delaware Agricultural Experiment Station. Contribution No. 70 of the Department of Plant Pathology.

[2] Assistant Research Professor and Graduate Assistant, respectively.

[3] Agrimycin-100, furnished by Charles Pfizer & Co., Inc., New York, contains 15% streptomycin and 1.5% oxytetracycline. For purpose of simplicity reference is made either to the material or to the streptomycin component.

[4] "Sprayit" model 274 oilless diaphragm type sprayer manufactured by the Electric Sprayit Co., Sheboygan, Wisconsin.

them on seeded plates to determine the relative inhibition zone of the antibiotic. Table 1 illustrates a representative test using Agrimycin as a spray at 250 ppm. The other tests were in essential agreement with this one.

A variation of the tests illustrated by Table 1 was carried out in two experiments. In these cases, the plants received 2 periods of simulated dew, each of 4-hours duration, in a 5-day period. This was done to more nearly simulate field conditions and to allow the antibiotic to be present in solution on the leaf surface part of the time rather than continuously in the dry state. The only effect of this dew treatment was to reduce the number of days the material was detectable in unwashed leaf samples to 5 or less. In neither case was streptomycin evident in the expressed sap from washed leaf samples.

The same procedure was followed using Agrimycin at 500 ppm. A total of 4 tests, involving 250 discs, were conducted. Of the 125 discs involved in the washed-leaf series, a total of 6 showed evidence of light zones in 2 of the tests; in the other 2 tests, no zones appeared. The appearance of these few zones is interpreted to mean inadequate washing of the leaf sample for the given harvest date.

Additional tests were conducted using plants just beginning to flower. Individual branchlets were covered with glycine bags prior to application of the antibiotic. One day after application, and periodically for the following 5 days, leaves from sprayed and unsprayed branchlets of the same plant were harvested and tested by the described bioassay method. In no instance was antibiotic acitvity detected in any of the leaves on the unsprayed branchlets.

An additional series of actively growing plants were sprayed with 125, 250, and 500 ppm for 1, 2, and 3 applications 4 days apart and allowed to develop new sets of foliage over a 10-day period. None of the foliage which developed after the application of the materials had detectable amounts of antibiotic present.

The data indicate that the spray form of Agrimycin used in these tests does not enter leaves of pepper plants and accumulate in amounts detectable by the bioassay method used. It does indicate, however, that in the absence of free moisture an application of 500 ppm will remain active on the leaf surface for more than 7 days.

A preliminary investigation has been made also on snapbean plants (variety Wade) using the same procedure outlined for pepper plants. The test organism used was Pseudomonas phaseolicola. The data obtained indicate that the spray form of Agrimycin does enter the leaves of snapbean. Unifoliate leaves receiving 1 application of 250 and 500 ppm streptomycin were harvested 24 hours after time of application. Samples were washed in running tap water, ground in a mortar, and tested in the manner previously described. In the 2 tests conducted, antibiotic zones averaging 8 mm. in diameter were consistently obtained from both washed and unwashed samples. Bean leaves receiving 1 application at 500 ppm streptomycin showed progressive yellowing and, by 3 days after treatment, developed large necrotic areas. Such a reaction has not been observed in pepper leaves.

The data above indicate that the two plants investigated, pepper and bean, respond differently to treatment with streptomycin. Goodman (2) has suggested that the waxy cuticle of apple leaves and stems might be a physical barrier to the entrance of streptomycin into the plant tissues. A similar condition might exist in the case of pepper leaves.

Protective Action of Agrimycin

A series of potted pepper plants were given 1, 2, and 3 applications of Agrimycin at 250 and 500 ppm. Four days after the final application, the plants were inoculated with a suspension of Xanthomonas vesicatoria and held in a moist chamber for 48 hours. The plants were removed to a greenhouse bench and scored 10 days later for the number of spots per leaf. The composite results of several of these tests are presented in Table 2.

It is evident that if the antibiotic is applied frequently at concentrations as high as 500 ppm the number of lesions per plant is greatly reduced. However, infection still occurs in plants receiving 3 applications of 500 ppm. This would further indicate that the antibiotic material is not actively present in the leaf to inhibit bacterial development.

Table 1. Zones of inhibition produced by expressed sap of pepper leaves having received one application of Agrimycin (250 ppm).

Time sap expressed after spraying (hrs.)	Leaf treatment before expressing sap	Average zone diameter[a] of 11 discs (mm)
6	Washed	0.0
	Unwashed	8.5
24	Washed	0.0
	Unwashed	10.0
48	Washed	0.0
	Unwashed	5.0
72	Washed	0.0
	Unwashed	8.0 (5 zones very hazy)
120	Washed	0.0
	Unwashed	4.5 (all very hazy)
168	Washed	0.0
	Unwashed	4.2[b]

[a] Figure is average diameter of zones minus 6 mm diameter of filter paper disc.
[b] Figure represents average of 3 zones. Eight discs did not exhibit zones.

Table 2. Protective action of Agrimycin on pepper leaves against infection by Xanthomonas vesicatoria.

Concentration (ppm)	Application[a] (No.)	Total no. leaves per plant	Leaves severely infected[b] (No.)	(%)
250	1	58	30	51.7
500	1	61	27	44.2
250	2	55	17	30.9
500	2	52	9	17.3
250	3	65	13	20.0
500	3	60	10	16.6
Untreated	-	59	51	86.4

[a] Applications made at 5-day intervals.
[b] Leaves with 5 or more spots per leaf were considered as severely infected.

Eradicant Action of Agrimycin

Pepper plants with leaves containing 5 or 6 spots caused by Xanthomonas vesicatoria per leaf were selected and treated as follows: (a) plants sprayed on each of 3 consecutive days with Agrimycin 250 ppm; (b) as in (a) but with addition of duPont spreader-sticker[5]; (c) plants sprayed on each of 3 consecutive days with Agrimycin at 500 ppm; (d) as in (c) but with addition of duPont spreader-sticker[5].

One day after treatment, infected leaves were picked from the plants in each of the four groups, washed in tap water, and individual lesions dissected from the leaves. The lesion tissue was macerated in several drops of sterile distilled water and the resulting juice then streaked on nutrient agar plates. X. vesicatoria was consistently reisolated from these lesions from sprayed leaves. Reisolates proved to be pathogenic in subsequent tests on potted peppers. The technique was also varied in that treated plants received a 4-hour "dew period" on 3 days. In this case, the 3 applications of antibiotic occurred over a 6 day period, alternating with the dew periods. Again, X. vesicatoria was successfully reisolated from lesions on leaves sprayed with the antibiotic.

To determine if the antibiotic was acting as a bacteriostatic or bactericidal agent, attempts were made to reisolate the organism from within the zone of clear agar produced around discs impregnated with streptomycin at 250 ppm and placed on the agar surface. By placing small amounts of the agar (taken adjacent to the disc) in broth tubes, it was found that the organism quickly resumed growth, indicating a bacteriostatic action against X. vesicatoria at this level of concentration of the antibiotic.

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DELAWARE AGRICULTURAL EXPERIMENT STATION

[5] Used at rate of 4 oz. per 100 gal. of water.

COMPATABILITY BETWEEN A STREPTOMYCIN-TERRAMYCIN FORMULATION[1] AND COPPER IN THE CONTROL OF BACTERIAL BLIGHT OF CELERY

R. S. Cox

Abstract

Agrimycin and neutral coppers, alone and in combination, gave a high degree of control of bacterial blight of celery. The materials in combination were more effective than either when used alone.

Although only one reference[2] to this disease in Florida has been noted, bacterial blight (Pseudomonas apii Jagger) is one of the most serious celery seedbed diseases in the Everglades. Lack of attention to this disease in the past may have been due to several factors: 1) it is seldom of importance in field plantings, although if adequate control is not obtained in the seedbed subsequent plantings in the field may suffer; 2) the disease appears to be a problem on only the early plantings (July to September)[3]; and 3) copper fungicides, long recommended for the control of this disease[2], were used exclusively in the celery seedbed until recent years.

In the Everglades, most celery growers believe that copper alone does not provide adequate control of seedbed diseases other than bacterial blight, e.g., damping-off and early blight. Since copper is not considered to be compatible with the organic fungicides used against these other diseases, a separate spray operation becomes necessary. As a result of this dual program, the interval between applications of copper is lengthened to at least once a week until bacterial blight appears. When this occurs, the growers attempt to spray twice weekly with copper, while at the same time continuing the alternate schedule with the organics. Since the disease is most destructive during the rainy period in the fall, field conditions frequently become such that it is not always possible to maintain this dual program. This is further aggravated by the size of operations, which makes schedules difficult to follow because of equipment shortage. It appeared desirable, therefore, to develop a more efficient spray program. One obvious approach would be through the testing of the antibiotic, streptomycin, separately and in mixture with copper against bacterial blight. This is a preliminary report on results obtained in 1954.

Materials and Methods

Sprays were applied with a commercial rig that delivered 200 pounds pressure. The test was done on standard 4 feet x 300 feet beds[4], and each plot consisted of three beds. The materials were applied at the rate of approximately 8 gallons to each bed. A total of five applications were made at weekly intervals, except for the second which was applied after 3 days. The treatments were randomized and replicated.

At the time of the first application the disease was uniformly distributed throughout the plots. Because of the rather high incidence, the Agrimycin (streptomycin) plots received heavy applications the first two times.

Discussion of Results

Pertinent data are shown in Table 1. It is seen that both Agrimycin and Copper A gave a high degree of control; also, the Agrimycin appeared to be more effective than copper. Where a straight copper schedule was used (Schedule D) the disease gradually built up, whereas with Agrimycin the opposite was the case.

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[1] The commercial formulation used (sold under the trade name, Agrimycin, and supplied by Charles Pfizer Company) contains the two ingredients in a 10-1 ratio.

[2] H. H. Wedgworth. 1931. Bacterial spot and early blight of celery. Florida Agr. Exp. Sta. Rept. 45: 156.

[3] The seedbed seeding period normally extends from the latter part of June through December or even later.

[4] The beds were furnished by the Wedgworth Farms, Belle Glade, Florida.

Table 1. Effect of various materials on bacterial blight severity, Belle Glade, Florida, 1954.

Treatment[a]	Concentration	Disease severity[c]	
		September 14	September 28
A. Check		2.75	8.25
B. Streptomycin-Terramycin (Agrimycin-100)	300 - 300 - 100 - 100 - 100 - ppm.	1.75	1.00
C. Streptomycin-Terramycin (Agrimycin-100)	600-600- 200 200 - 200 - ppm.[b]	1.00	0.50
D. Copper A (45% C-O-C-S)	4 lbs./100 gal.	1.25	2.25
E. Streptomycin-Terramycin plus Copper A	Schedules B plus D	0.50	0.25
LSD .05			1.97

[a] Materials applied on following dates: September 4, 7, 14, 21, 28. In another test the following materials used alone were ineffective: zineb, captan, dichlone, chloranil, ferbam, ziram, and Lo 738.

[b] Parts per million of streptomycin in 100 gallons.

[c] Disease severity scored on a 0 to 11 basis.

Perhaps more significant, however, was the effect of these two materials in mixture. The combination appeared more effective than either material used alone; although it was not significantly better than the straight streptomycin-Terramycin material (compare Schedules E and B).

The question naturally arises as to the type of action involved in this mixture. It appears safe to conclude that these materials, i.e., streptomycin-Terramycin and Copper A, were completely compatible. Also, the data suggest, although they do not show statistically, that the combination has an additive effect in respect to reducing the incidence of bacterial blight. If the effect is additive the question then arises as to whether the action should be classed as that of synergism. Horsfall[5] would call it supplementary synergism. There was no indication of true synergistic action (the total effect greater than the sum of the two effects taken independently). These data do not preclude this possibility, however, because of the high degree of effectiveness of each material when used alone. Further work for clarification of these important points is needed.

This work does indicate, nevertheless, that by employing the proper mixture of streptomycin-Terramycin and copper-containing pesticides (in other limited tests tribasic copper sulfate showed the same effect in the mixture), adequate control of bacterial blight of celery in the seedbed could be obtained with weekly applications, instead of semi-weekly as is necessary where a straight copper program is followed.

Summary

In repeated tests during the 1954-55 season weekly applications of streptomycin formulations gave commercial control of bacterial spot of pepper (Xanthomonas vesicatoria). In a dosage series of 100 to 1000 ppm, effectiveness as measured by disease severity increased up to 400 ppm. Yield increases were as much as 50 percent over that of the checks.

The neutral coppers also provided an effective degree of control as measured by foliar disease severity.

[5] Horsfall, James G. 1945. Fungicides and their Action. Chronica Botanica Co.

The neutral coppers were completely compatible with streptomycin (Agrimycin), and there appeared to be a considerable additive effect when the two were used in combination (2 to 4 pounds of neutral copper with 100 to 200 ppm of streptomycin).

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IN VITRO SENSITIVITY OF PLANT BACTERIAL PATHOGENS TO ANTIBIOTICS AND ANTIBACTERIAL SUBSTANCES

B. S. Morgan and R. N. Goodman[1]

During the past four or five years considerable research has been done in phytopathology with antibiotics as therapeutic agents for plant diseases. To date, a majority of the investigations, both in vitro and in vivo, have employed these substances against bacterial plant pathogens.

The literature contains a number of accounts of the in vitro activity of antibiotics. Perhaps the most extensive of these is the study conducted by Katznelson and Sutton[2]. However, most of the recorded investigations have tested either a limited number of antibiotics or, conversely, determined the sensitivity of relatively few pathogens to these new drugs. Furthermore, the procedures employed and the experimental conditions that prevailed in the evaluations of bacterial sensitivity to antibiotics varied considerably with the investigator.

Thus it was apparent that it would be of more than academic interest to determine the sensitivity of a significant number of the more troublesome plant bacterial pathogens to the most prominent antibiotics available at this time. In this respect the current study has attempted to evaluate the efficacies of eight antibiotics, two synthetic antibacterial substances, and an antibiotic combination in inhibiting 14 phyto-bacterial pathogens. At least one species from each of the five genera of bacterial plant pathogens was included in this investigation.

Two procedures are currently employed in determining the sensitivity of bacteria to antibiotics: they are the "paper disk-agar diffusion" and the "tube dilution" methods. Both have been extensively used by the authors.

The agar diffusion technique is perhaps resorted to most frequently since the manipulations are easily and rapidly performed. However, this technique is primarily a quantitative one. The tube dilution method is more sensitive, provides a greater degree of reproducibility, is ideal for studying the effects of antibiotic combinations, and permits the measurement of bacteriastatic and bacteriacidal concentrations. In addition, it is possible with this procedure to obtain results rapidly, usually within 6 to 12 hours, thus making it unnecessary to utilize complete aseptic procedures. With the agar diffusion technique incubation periods frequently exceed 24 hours, which is undesirable when a labile antimicrobial agent is under investigation.

Procedures

Bacterial cultures were maintained on both nutrient agar and nutrient broth and stored at 5° C. Prior to testing, each organism was cultured in nutrient broth, plated out on agar, and examined for the presence of abnormal growth characteristics and contaminants.

The antibiotics were in some instances highly refined and in others crude preparations. However, all solutions were prepared on an activity basis and are expressed throughout this communication in mcg./ml. Stock solutions of antibiotics were prepared at weekly intervals and stored at 5° C.

Nine milliliters of 1 percent peptone broth were measured into test tubes (1.5 x 15.0 cm.) and sterilized. The antibiotics to be tested were serially diluted in eight tubes wherein the maximum and minimum concentrations were usually 12.5 and 0.1 mcg./ml. The antibiotic stock solutions were prepared so that the addition of 1.0 ml. to 9.0 ml. of peptone provided the desired final concentration.

Inoculum of the test organism was obtained by one 3 mm.-loop transfer from nutrient broth to 1 percent peptone and incubated 18 hours at 28° C. The serially diluted antibiotic was then seeded with 0.1 ml. of the 18-hour culture.

Observations were made 12 hours after inoculation for the the presence of turbidity. No attempt was made to evaluate the differences in degree of turbidity and the endpoint was considered to be the lowest concentration at which growth was completely inhibited.

The antibiotic solutions were not sterile; however, aseptic techniques were used in adding antibiotics and inocula to the peptone.

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[1] Graduate Student and Assistant Professor in Department of Horticulture, University of Missouri.
Contribution from the Missouri Agricultural Experiment Station, Journal Series No. 1528. Approved by Director.

[2] Katznelson, H., and M. D. Sutton. 1951. Inhibition of plant pathogenic bacteria in vitro by antibiotics and quaternary ammonium compounds. Canadian Jour. Bot. 29: 270-278.

Table 1. Sensitivity of bacterial plant pathogens to antibiotics.

Test organism	Antibiotic: Aureomycin mcg./ml.	Neomycin mcg./ml.	Terramycin mcg./ml.	Streptomycin mcg./ml.
Agrobacterium tumefaciens	.025	.4	.05	.4
Corynebacterium michiganense	.1	.1	.2	.05
Erwinia amylovora	.2	.25	.6	.2
Erwinia carotovora	1.6	.4	6.3	.8
Pseudomonas phaseolicola	.1	.1	.2	.1
Pseudomonas pisi	1.6	.8	6.3	+12.5[a]
Pseudomonas sesami	.4	.2	.8	3.2
Pseudomonas solanacearum	.1	3.2	.8	.8
Pseudomonas syringae	.4	.1	.4	.2
Xanthomonas campestris	.2	.1	.8	.8
Xanthomonas malvacearum	.05	.2	.8	.2
Xanthomonas phaseoli	.1	.1	.8	.1
Xanthomonas pruni	.3	.5	1.4	.4
Xanthomonas ricinicola	.2	.1	.4	.4

[a] +12.5 indicates inhibition not complete at that concentration.

Table 2. Sensitivity of bacterial plant pathogens to antibiotics.

Test organism	Antibiotic: Polymyxin mcg./ml.	Streptothricin mcg./ml.	Viomycin mcg./ml.	Chloromycetin mcg./ml.
Agrobacterium tumefaciens	3.2	3.2	3.2	+12.5
Corynebacterium michiganense	.4	.4	.1	.8
Erwinia amylovora	.13	.1	1.2	.9
Erwinia carotovora	.2	.4	6.3	3.2
Pseudomonas phaseolicola	.1	.1	--	6.3
Pseudomonas pisi	.4	+12.5	1.6	+12.5
Pseudomonas sesami	.4	.2	3.2	6.3
Pseudomonas solanacearum	+12.5	.8	+12.5	+12.5
Pseudomonas syringae	.4	.8	1.6	6.3
Xanthomonas campestris	.2	1.6	12.5	6.3
Xanthomonas malvacearum	.2	.1	1.6	1.6
Xanthomonas phaseoli	.2	.2	.8	6.3
Xanthomonas pruni	.51	.25	2.1	7.9
Xanthomonas ricinicola	.4	.2	+12.5	6.3

Table 3. Sensitivity of bacterial plant pathogens to antibiotic formulations and antibacterial substances.

Test organisms	Antibiotic combination	Antibacterial substances[b]	
	Agrimycin-100[a] mcg./ml.	1439 mcg./ml.	1484 mcg./ml.
Agrobacterium tumefaciens	.4	+3.2	1.6
Corynebacterium michiganense	.1	.1	.1
Erwinia amylovora	.1	.9	1.0
Erwinia carotovora	.2	.4	.8
Pseudomonas phaseolicola	.1	.2	.4
Pseudomonas pisi	12.5	+12.5	+12.5
Pseudomonas sesami	.4	.4	.4
Pseudomonas solanacearum	.8	.8	.8
Pseudomonas syringae	.2	1.6	1.6
Xanthomonas campestris	.2	1.6	1.6
Xanthomonas malvacearum	.1	.1	.4
Xanthomonas phaseoli	.1	.1	.2
Xanthomonas pruni	.16	.95	3.3
Xanthomonas ricinicola	.4	.1	.1

[a] Agrimycin-100 Trademarked formulation of Chas. Pfizer and Co., Inc., containing 15% streptomycin and 1.5% Terramycin.
[b] 1439 and 1484 are N-hydroxy-2 pyridinethione and 2-pyridinethiol, 1-oxide salt, produced by Olin-Mathieson Chemical Corporation.

Results

The sensitivities of 14 phytopathogenic bacteria to antibiotics are recorded in Tables 1 and 2. These data indicate that the antibiotics tested varied considerably in their capacity to inhibit the entire spectrum of test organisms. Although no one antibiotic was consistently superior, it is apparent that of materials tested Aureomycin was most effective against a majority of the pathogens. For example, Agrobacterium tumefaciens was inhibited at the extremely low concentration of 0.025 mcg./ml., whereas the minimum inhibitory concentration for the more resistant organisms, Erwinia carotovora and Pseudomonas pisi, was only 1.6 mcg./ml.

Neomycin, also a relatively broad-spectrum antibiotic, may be regarded as the second most active substance. This antibiotic, though generally less effective than Aureomycin, was superior to the latter in suppressing E. carotovora and P. pisi.

Streptomycin, Terramycin, polymyxin, and streptothricin varied appreciably with respect to the organisms each was most effective against, yet their overall order of activity was quite similar.

Viomycin and chloromycetin showed the lowest order of activity against most of the organisms tested. In only a few instances were their minimum inhibitory concentrations comparable with those of the other antibiotics.

In these experiments Pseudomonas pisi and P. solanacearum, and Erwinia carotovora demonstrated the greatest resistance to antibiotics. It is of some interest to note that the antibiotics most effective against P. pisi and E. carotovora were not foremost in suppressing P. solanacearum. Both P. pisi and E. carotovora required 1.6 mcg./ml. of Aureomycin and 6.3 mcg./ml. of Terramycin to prevent growth, whereas growth of these organisms was inhibited by neomycin and polymyxin at concentrations less than 1.0 mcg./ml. On the other hand P. solanacearum was relatively insensitive to either neomycin or polymyxin, yet it was inhibited by low concentrations of Aureomycin and Terramycin.

The effectiveness of Agrimycin-100 and the two pyrimidinethione compounds, 1439 and 1484, against the test spectrum of phytopathogenic bacteria is presented in Table 3.

Since the concentration of Agrimycin was calculated on a total antibiotic activity basis an interesting comparison can be made between this formulation and streptomycin. Of the 14 test pathogens, seven were more sensitive to the combination, there was no difference in six, and in one instance, Corynebacterium michiganense, a slight antagonistic effect was observed. Com-

paring the combination with Terramycin finds the streptomycin-Terramycin combination superior against 11 organisms, equal against two, and antagonistic in one instance, Agrobacterium tumefaciens.

The very excellent in vitro performance of the two synthetic materials suggests that these should receive further attention in vivo.

DEPARTMENT OF HORTICULTURE, UNIVERSITY OF MISSOURI

THE INFLUENCE OF ACTIDIONE AND OTHER CHEMICALS UPON THE OAK WILT FUNGUS

Charles L. Fergus, Herbert Cole, Jr., and William J. Stambaugh[1]

Abstract

Actidione (cycloheximide) was the most toxic to Endoconidiophora fagacearum Bretz of all the chemicals tested. Dissolved in malt extract agar, it completely inhibited germination of endoconidia and ascospores at 1.0 microgram per milliliter. No growth occurred at this concentration. Pentachlorophenol, copper sulfate, and sodium arsenite were toxic, but greater concentrations were required for complete inhibition. Ammate (ammonium sulfamate) was the least toxic of the chemicals tested. Actidione, added to previously established growth in liquid, inhibited further growth 76 percent at a concentration of 0.01 microgram per milliliter. The fungus was less sensitive to Actidione when the chemical was sprayed onto mycelium. However, sprays of Actidione (10 micrograms per milliliter) onto oak sapwood reduced mycelial invasion by 90 percent, thus offering some hope for its use in prevention of mat formation. The toxicity of Actidione at such low concentrations warrants further investigation under forest conditions for oak wilt control. Its possible use as a chemotherapeutant for shade trees should also be studied.

Actidione (cycloheximide), an antibiotic produced by Streptomyces griseus, has been shown to be inhibitory to many plant pathogens by Whiffen (7). This compound has offered considerable promise in the control of plant diseases, including powdery mildew of beans (3), cherry leaf spot (1, 6), and covered smut of oats (4). One possible method of prevention of overland, long-distance spread of oak wilt, caused by Endoconidiophora fagacearum Bretz, is by the use of chemicals to prevent formation of the mycelial mats, which are probably the most important sources of primary inoculum. In this study, then, the effect of Actidione[2] on growth and spore germination of the oak wilt fungus was examined, and the results compared with those of other chemicals at present used in attempts to control oak wilt.

Actidione, Ammate (ammonium sulfamate), sodium arsenite, copper sulfate, and pentachlorophenol were tested by dissolving in malt extract agar.

The basic medium consisted of 1.5 g. Difco malt extract and 1.5 g. agar per 100 ml. of solution. The medium was autoclaved and cooled to 50° C and sufficient quantities of the various chemicals were added to produce the desired concentrations (Table 1). This method of addition was used to eliminate any possible reduction of toxicity by autoclaving. Aqueous endoconidial suspensions of the oak wilt fungus were obtained from 10-day-old malt extract agar slant cultures. The spore concentration was adjusted to 200,000 per milliliter, Fuchs-Rosenthal counting slide. One drop of the spore suspension was pipetted onto the center of the plates containing 20 ml. of the test media. Each test was replicated five times. The effect of the chemicals was evaluated by checking spore germination after 24, 48, and 72 hours, and growth after 14 days.

The results of this experiment are presented in Table 1. Actidione was the most effective of all the chemicals tested, completely inhibiting germination of endoconidia and ascospores at 1.0 microgram per milliliter. The endoconidia were more sensitive than the ascospores to Actidione since none germinated at 0.1 micrograms per milliliter, whereas 3 percent of the ascospores germinated at the same concentration; however, the germ tubes failed to continue development. No growth occurred at concentrations of 0.1 microgram per milliliter or greater. Although growth occurred at 0.01 microgram per milliliter, it was reduced about 75 percent. Germination occurred at various concentrations of pentachlorophenol, but growth was strongly inhibited at 25 micrograms per milliliter. Ammate was the least toxic of all the chemicals tested; 2000 micrograms per milliliter allowed high germination, but growth was inhibited approximately 50 percent.

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[1] Associate Professor, Research Assistant and Instructor respectively. Contribution No. 194 of the Department of Botany and Plant Pathology, Pennsylvania Agricultural Experiment Station. Authorized for publication May 2, 1955, as paper No. 1975 in the Journal Series.

[2] The authors wish to express their appreciation to the Upjohn Company, Kalamazoo, Michigan, for kindly supplying the Actidione used.

Table 1. Growth and percentage spore germination of Endoconidiophora fagacearum on agar containing toxic chemicals[a].

Chemical	Concentration: Micrograms per milliliter	Percent germination: Ascospores	Percent germination: Endoconidia	Growth: Diameter (mm.)
Actidione	1	0	0	0
	0.1	3	0	0
	0.01	84	86	25
	0.001	90	90	35
Ammate	30,000	38	30	0
	22,000	50	47	17
	10,000	76	78	30
	2,000	90	88	35
Sodium arsenite	250	0	0	0
	25	60	54	60
	2.5	80	79	65
Copper sulfate	500	0	0	0
	250	65	71	40
	25	77	69	40
"Penta"[b]	1,250	0	0	0
	500	3	2	1
	250	9	4	2
	25	14	11	2
Malt extract		87	91	80

[a] Additional concentrations were tested, but only significant values are listed for brevity.
[b] Commercial preparation by Chapman Co. containing 5% pentachlorophenol in hydrocarbon base.

Table 2. Effect of Actidione on colony diameter increase of Endoconidiophora fagacearum on malt extract agar plates.

Treatment micrograms per milliliter	Colony diameter increase (in mm.): 7 days after treatment	14 days after treatment
Actidione		
0.1	17 x 20[a]	35 x 35[a]
1	5 x 9[b]	10 x 15[b]
10	2 x 2[b]	2 x 5[b]
100	0	0
Control	20 x 25	37 x 37

[a] Some aerial growth.
[b] Growth increase mostly by spread under the agar surface.

Because of the inhibitory effect of Actidione in the preliminary test, it was further tested in liquid culture against previously established growth. The basic medium consisted of 100 ml. of 1.5% Difco malt extract in 250 ml. Erlenmeyer flasks. Each flask was inoculated with 0.1 ml. of spore suspension (200,000 spores per ml.) and incubated at 25° C for 5 days. Actidione was added to each flask to produce concentrations of 0.01 and 0.001 micrograms per milliliter. Fungus growth in these flasks was checked against growth in the basal medium alone. Three flasks of each of the three series were removed at 10, 15, 20, 25, and 30 days, the mycelium filtered through tared filter papers, and the oven-dry weight of mycelium determined for each flask.

Growth of Endoconidiophora fagacearum in malt extract solution, although well established (20 milligrams dry weight) after 5 days when Actidione was added, was inhibited 76 percent by 0.01 micrograms per milliliter and 60 percent by 0.001 micrograms per milliliter after 30 days. The controls contained 185 milligrams dry weight mycelium at the end of the experiment.

Actidione was also tested as a spray on previously established fungus growth on oak sapwood and malt extract agar. Padless mycelial mats of two different Pennsylvania isolates were obtained, using Curl's method (2) of growing E. fagacearum on healthy red oak sapwood slants placed on end in Erlenmeyer flasks containing wheat bran broth. Two isolates were used which yielded growth more similar to mat growth in nature than any others of ten isolates tested. One-half of the mats were spermatized with endoconidia of appropriate compatibility.

The endoconidial and ascosporic mats were scribed into two equal sections. One-half of each mat was sprayed with Actidione with a DeVilbiss No. 15 atomizer, while the other half served as a control. Each group was atomized sufficiently to produce an intact film of Actidione solution over the mycelium. After 24 hours, one mycelial disc was removed from the control portion and two removed from the treated portion of endoconidial mats using a sterile No. 2 cork borer. Each disc was placed in a 10 ml. sterile water blank, macerated, and germination tested on malt extract agar. Ascospore masses were removed from the treated perithecial mats, macerated in sterile distilled water, and germination tested on malt extract agar.

The atomization of Actidione onto mats developed on oak sapwood did not adversely affect the germinability of endoconidia and ascospores. Transplants of the atomized mycelium grew normally on malt extract agar.

The effect of atomizing Actidione onto 7-day-old colonies on malt extract agar is presented in Table 2.

Complete inhibition of growth occurred at a concentration above 10 micrograms per milliliter; however, 1 microgram per milliliter reduced growth one-third and practically all of this growth was submerged, indicating that the Actidione did not penetrate below the agar surface. Transfers of mycelium, 16 days after treatment with 100 micrograms per milliliter, yielded viable colonies of E. fagacearum.

The ability of Actidione to prevent mycelial growth into sprayed sapwood was also examined. The bottom portions of red oak sapwood slants were washed with spore suspensions of two different Pennsylvania isolates, placed in sterile flasks containing wheat bran broth, and incubated at 25° C for 10 days. The maximum linear growth up the slants was measured, then some of the slants were atomized to the margin of mycelial growth with Actidione (1 and 10 micrograms per milliliter distilled water), incubated at 25°, and growth recorded 5 and 10 days following atomization.

Actidione sprays reduced mycelial growth and development 50 percent at 1 microgram per milliliter, and 90 percent at 10 micrograms per milliliter.

Discussion and Summary

Actidione was the most toxic to spore germination and growth of Endoconidiophora fagacearum of the five chemicals tested. Spore germination and mycelial growth were equally affected when the chemical was dissolved in agar. Hoffman (5) studied the effect of many chemicals on endoconidial germination of the oak wilt fungus and reported copper sulfate and sodium pentachlorophenate as more toxic to germination than was found in this investigation. However, direct comparisons to his results are not possible since the methods employed were different.

Mycelial growth already established in liquid was inhibited 76 percent by 0.01 micrograms per milliliter of Actidione. Growth resulting from spores germinating on agar containing an equivalent concentration was inhibited 69 percent, a remarkably similar result.

The fungus was less sensitive to Actidione sprayed onto mycelium than when the antibiotic was added to the liquid in which the fungus was already growing. This may be due to failure of

penetration of the chemical to all underlying hyphae or failure to diffuse equally into all hyphae.

Sprays of Actidione (10 micrograms per milliliter) onto oak sapwood reduced mycelial invasion by 90 percent, thus offering some hope for its use in prevention of mat formation. The toxicity of Actidione to Endoconidiophora fagacearum warrants further investigation under forest conditions for the control of oak wilt. The use of the antibiotic as a chemotherapeutant for ornamental and shade trees should also be investigated.

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SOME ADDITIONAL NATIVE AND EXOTIC SPECIES OF FAGACEAE SUSCEPTIBLE TO OAK WILT

T. W. Bretz[1]

All species of oak, and related species in the family Fagaceae, that have been subjected either to natural or artificial inoculation with the oak wilt fungus, Endoconidiophora fagacearum, have proved to be susceptible. To date 33 species and varieties of Quercus, 3 species of Castanea, 1 species of Castanopsis, and 1 species of Lithocarpus have been reported as susceptes (1, 2, 3). About one-half of these occur naturally in the area in which oak wilt is known to occur. A few are exotics that are grown to some extent within the known range of the disease and a number are native to the United States but do not grow where the fungus occurs.

Because the species common to the area in which oak wilt is known to occur appear to be generally susceptible to the disease, it seemed desirable to determine the susceptibility of species which occur elsewhere, particularly those of foreign origin. Immunity or a high degree of resistance to the disease in such stock might be of potential value in obtaining desirable oak wilt resistant lines and might provide, as well, a clue to the possible origin of the disease.

Through the cooperation of several agencies and individuals it was possible to assemble a collection consisting of exotic species native to rather diverse areas of the world, as well as species of rather restricted distribution in North America. Several of the exotic species are grown in this country and are used to a limited extent for ornamental purposes in certain sections. Commercial nursery stock of these species was used when obtainable. The majority of stock, however, was grown from seed of known origin. Species of doubtful hardiness in Missouri were grown in pots under greenhouse conditions. Hardy species were planted out of doors in nursery beds. With the exception of some stock obtained from commercial sources, the trees were 1 and 2 years old when inoculated.

Inoculations were made when the trees were putting out new vegetative growth. The inoculum consisted of suspensions of endoconidia washed from virulent, tubed cultures of the oak wilt fungus. Under greenhouse conditions the inoculations were made by placing drops of spore suspension in the leaf axils and puncturing the stem under the drops with a sterile dissecting needle. Inoculations in the nursery were made by cutting into the wood of the stem with a sterile scalpel or knife blade, applying the spore suspension at the time the cut was made. Both methods resulted in an immediate uptake by the plant of the spore suspension.

In all species, symptom development began within 3 to 5 weeks after date of inoculation and in general followed the typical sequence of development described for the disease. In some instances basal sprouting or the stimulation of axillary branch development accompanied the progression of foliage symptoms. Vascular discoloration was pronounced in some instances and was very slight or entirely lacking in others. For all species infection was proven by reisolation of the fungus.

The susceptibility of 16 additional species of Quercus, one species of Castanopsis, and one species of Lithocarpus to oak wilt has been demonstrated. All species are of foreign origin except two Quercus species that are native to the West Coast of the United States. In addition the susceptibility of several native and exotic species previously reported as suscepts was confirmed and they are included here since they represent collections of different origin than the collections used previously. Information regarding the identity of the species, their native range, source of stock and the test conditions, is compiled in Table 1.

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[1] Professor of Forestry, University of Missouri, Columbia, Missouri. Formerly Plant Pathologist, United States Department of Agriculture, Agricultural Research Service. Contribution from the Missouri Agricultural Experiment Station, Journal Series 1533. Approved by Director.

Table 1. Some additional native and exotic species of Fagaceae susceptible to oak wilt.

Scientific name	Common name	Native range	Source of stock	Test conditions
Quercus acuta	Japanese evergreen oak	Japan, Korea	Commercial nursery	Greenhouse
Q. acutissima*[a]	Sawtooth oak	North China, Japan	Japan[b]	Greenhouse
Q. agrifolia*	California live oak	California, Lower California, Mexico	California[c]	Greenhouse
Q. aliena var. acutesserrata (2 accessions)	Oriental white oak	Japan, Central China	Arnold Arboretum[d]	Nursery
Q. castaneaefolia	Caucasus oak	Western Asia to Northern Persia	Italy[b]	Greenhouse
Q. cerris	European turkey oak	South East Europe, Western Asia	France[b]	Nursery
Q. chrysolepis*	Canyon live oak	Washington, Oregon, California	California[c]	Greenhouse
Q. glandulifera (2 accessions)		Japan, Korea, Western China	England[b] Arnold Arboretum[d]	Nursery
Q. glauca	Blue Japanese oak	Japan	Commercial Nursery	Greenhouse
Q. haas		Eastern Europe, Western Asia	France[b]	Nursery
Q. ilex (2 accessions)	Holly oak	Southern Europe	Commercial Nursery France[b]	Greenhouse Nursery
Q. lobata	California white oak	California	California[c]	Greenhouse
Q. longinux (2 accessions)		Formosa	Formosa[b]	Greenhouse
Q. macrolepis		Eastern Europe, Western Asia	France[b]	Nursery
Q. myrsinaefolia		Japan	Georgia, USA[b]	Greenhouse Nursery
Q. robur* (Q. pedunculata)	English oak	Europe, North Africa, Western Asia	Scotland[b]	Nursery
Q. thomasii		Italy	Italy[b]	Greenhouse
Q. variabilis	Oriental oak	North China, Japan	Arnold Arboretum[d]	Nursery
Q. sp. (Unidentified)			Okinawa[b]	Greenhouse
Q. virginiana*	Live oak	Southern United States	Mississippi[e]	Greenhouse
Q. wislizeni	Interior live oak	California, Lower California, Mexico	California[c]	Greenhouse
Castanopsis kawakamii		Formosa	Formosa[b]	Greenhouse
Lithocarpus densiflorus*	Tanoak	Southern Oregon, California	California[c]	Greenhouse
L. glaber (Quercus glabra)		Japan	Italy[b]	Greenhouse

[a] Previously reported susceptible.

Seed obtained through the cooperation of the following:

[b] Plant Introduction Section, Horticultural Crops Research Branch, Agricultural Research Service, U. S. Department of Agriculture.

[c] Dr. W. W. Wagener, California Forest and Range Experiment Station, U. S. Forest Service, U. S. Department of Agriculture.

[d] Dr. Donald Wyman, Arnold Arboretum, Jamaica Plain, Mass.

[e] Dr. Keith Parris, Mississippi State College, State College, Miss.

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MISSOURI AGRICULTURAL EXPERIMENT STATION IN COOPERATION WITH THE UNITED STATES DEPARTMENT OF AGRICULTURE

TRANSMISSION OF OAK WILT BY TOOLS

T. W. Jones and T. W. Bretz[1]

The possible transmission of the oak wilt fungus (Endoconidiophora fagacearum Bretz) from diseased to healthy trees by tools used on both is of concern to arborists, foresters, and owners who wish to protect their trees from the oak wilt disease. In 1953 a study was begun in the Missouri Ozarks (Butler County) to investigate this means of transmitting the disease. Slicing and sawing tools were used to make bole and crown wounds in healthy trees after the tools had been artificially contaminated or after they had been used in wood from trees known to have wilt.

The tools used were an ax, pole pruner, pruning saw, and pole saw. The four types of wounds made with these tools were a single ax hack, extending into the heartwood; a single saw cut, extending into the heartwood; pruning wound made by removing a lateral branch approximately 1.5 inches in diameter with a pole pruner; and a pruning wound made by removing a lateral branch approximately 1.5 inches in diameter with a pole saw.

Table 1. Percentage of treated trees that developed oak wilt, by treatment and dates. (Each treatment applied to 10 trees on each date).

Tool	Source of inoculum	Treatment dates					
		Feb.	April	May	June	July	All
Ax	Spore suspension	70	90	100	20	0	56
	Diseased wood	0	0	0	0	0	0
	Sterile	0	0	0	0	0	0
Pole pruner	Spore suspension	10	10	30	10	20	16
	Diseased wood	0	0	0	0	0	0
	Sterile	0	0	0	0	0	0
Saw	Spore suspension	60	60	90	0	10	44
	Diseased wood	0	0	0	0	0	0
	Sterile	0	0	0	0	0	0
Pole saw	Spore suspension	30	0	30	0	10	14
	Diseased wood	0	0	0	0	0	0
	Sterile	0	0	0	0	0	0
All	Spore suspension	42	40	62	7	10	32
	Diseased wood	0	0	0	0	0	0
	Sterile	0	0	0	0	0	0
Spore suspension in chisel wound		50	60	100	0	20	46

One series of wounds was made with tools that were artificially contaminated by moistening the cutting edge with a suspension of conidia and ascospores of the oak wilt fungus just prior to each cut made on a healthy test tree. Another series was made with tools that were used in wood from known diseased trees just prior to each cut made on a healthy test tree. A third

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series was made with sterile tools. To establish the virulence of the inoculum, a series of trees was also inoculated by introducing some spore suspension into chisel cuts that extended into the sapwood of the bole.

The study was conducted in a second-growth oak-hickory stand that was free of natural oak wilt infection. Altogether, 650 trees of the red oak group, ranging from 1 to 11 inches in diameter, were treated. Each treatment was applied to 10 trees on each of 5 dates: February 3, April 8, May 13, June 6, and July 15, 1953. All trees were examined periodically throughout the summer of 1953 and early summer of 1954 for symptoms of oak wilt.

The results of the study are presented in Table 1. About half of the trees receiving inoculum in chisel wounds and half of those wounded on the bole with an artificially contaminated ax or saw developed oak wilt. It is of interest to note that the percentage of successful transmissions from inoculations made in June and July was much lower than those made in February, April, and May.

The fungus was transmitted rather readily on each of the tools used during some period of the study if the tool was artificially contaminated with the disease organism. On the other hand, there was no transmission on tools used in wood from diseased trees. This failure to contaminate such tools would suggest that the fungus was not present in that portion of the diseased wood in which the tool was used, or if present, it did not adhere to the tools in a manner that would permit successful transmission.

CENTRAL STATES FOREST EXPERIMENT STATION, FOREST SERVICE, U. S. DEPARTMENT OF AGRICULTURE, AND MISSOURI AGRICULTURAL EXPERIMENT STATION

TRANSLOCATION PAST BARK LESIONS ON YOUNG WESTERN WHITE PINE[1]

Ernest E. Hubert, William K. Ferrell, and Frederic D. Johnson[2]

Pole blight of western white pine (Pinus monticola) is a serious threat to that species in its commercial range, where it is the most valuable timber species. One aspect of study of this disease was the testing of the effect of artificially produced bark lesions on the translocation and absorption of liquids in young trees. The fungus used to produce the lesions was No. 77, a species of Leptographium isolated from a root of a pole blighted tree (3). Leptographium spp., usually associated with a blue sapstain, have been consistently isolated from pole blight root and stem lesions. Their possible relation to pole blight has been discussed by Hubert (2).

Upper crown abnormalities are believed to be a constant symptom of pole blight while stem lesions or dead faces are also associated with the disease (1). It was believed that tracing liquid movements past artificial lesions might offer some explanation for mineral deficiencies noted in the crowns of pole blighted trees (unpublished data) and thereby aid in understanding the development of crown symptoms.

This study, although not conclusive, seems worth reporting since it will not be carried further, owing to the death of the senior author.

Materials and Methods

Healthy western white pine seedlings from 8 to 18 years of age were collected in the field and potted in 14-inch clay pots. The trees ranged in height from 3 to 5 feet and in diameter at the root collar from 3/4 to 1 1/2 inches. They were acclimated in a cool greenhouse at least 5 months before being inoculated. Only trees which had healthy, vigorous tops were selected for inoculation or control.

Inoculations were made in three areas -- roots, stems, and branches; only one area was treated on each tree. Prior to inoculation, the areas were cleaned, swabbed with alcohol, and punctured with a sterile needle after the alcohol had dried. Punctures were made completely around each root, stem, or branch in a band about 1 inch wide. The inoculum, taken from vigorous cultures growing on malt agar slants, was smeared over the entire punctured area. The area was immediately covered with a band of moist cotton held in place by a spiral wrapping of masking tape; the upper edge of the cotton being left exposed to permit periodic moistening of the cotton. Control trees were chosen and treated in the same manner, excepting that the inoculation with the fungus culture was omitted.

Within 30 to 40 days after inoculation, typical sunken areas or lesions were produced (Fig. 1-A), completely encircling the stem, branch, or root. Death of the tree above stem lesions occurred 50 to 65 days after inoculation; branch and root lesions caused death of the portions distal to the lesion in about the same length of time. The inoculation fungus was re-isolated from typical lesions.

The histology and symptomatology of Leptographium lesions has been reported (2), hence these results will be but briefly summarized here. The top symptoms are: gradual wilting of needles which become twisted and grey-green in death while the bark becomes wrinkled, dry and grey-green. Lesion areas exhibit a heavy external resinosis. Fungus hyphae are abundant in all parts of the phloem, and invade the xylem through the ray parenchyma. In the xylem, hyphae often anastamose in the tracheids and resin ducts; bladder hyphae which completely plug tracheids are occasionally found. When the xylem tissues develop a blue-grey stain, both the ray cells and the tracheids become filled with convolute hyphae. Extensive resin deposits in tracheids are common.

Radiophosphorus (P-32) was used in these tests to trace the upward and downward movement of this element past lesions. To determine upward movement, feeder roots and excised branches bearing lesions were immersed in a radioactive solution (Fig. 1-B and D), whereas downward movement past a lesion was traced by immersing needles of a branch in the P-32 solution (Fig. 1-C). The radiophosphorous solution used was 0.001 M. H_3PO_4 having a pH of about 4.0 and an activity of 1/2 to 1 millicurie per liter.

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[1] A phase of the cooperative project between the Atomic Energy Commission (Contract No. AT(45-1)-373) and the Forest, Wildlife and Range Experiment Station, University of Idaho.

[2] Late Research Pathologist, Assistant Professor, and Radioisotopes Technologist, respectively, Forest, Wildlife and Range Experiment Station, University of Idaho.

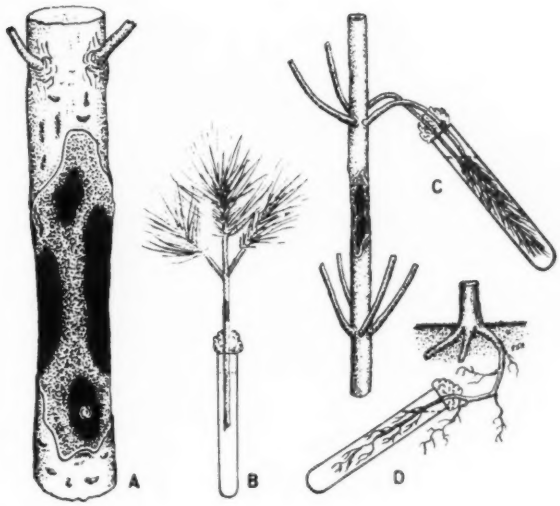

FIGURE 1. Methods used in obtaining absorption of P-32 by needles, stems and roots of young western white pines. A -- Typical bark lesion or sunken area produced by inoculation with Leptographium No. 77. Immersion in the radioactive solution of branches-B, needles-C, and roots-D.

The length of time the parts were in the radioactive solution varied from 3 to 24 days and depended on the location of sufficient activity in the desired areas by means of a field monitoring meter. Absorption and subsequent movement of the P-32 was fastest in the cut ends of branches, sufficient activity being detected in 3 days about 1 inch above the lesion (about 6 inches above the liquid, Fig. 1-B). Absorption through the roots was slower and the average immersion time for most roots was 13 to 14 days; however, some roots were left in the solution for 21 days. The isotope moved 24 inches to the stem lesions and about 3 inches to the root lesions. Absorption through the needles was slowest, the time of immersion varying from 21 to 24 days, the isotope moving about 6 to 10 inches from the immersed needles to the lesions.

At the end of the immersion period, the branches, stems, or roots were cut above and below the lesion or punctured area (controls). Samples were taken about 1/8 inch above and below the lesion; the branches which had the cut ends in solution were sampled only above the lesion. The samples were wet ashed and the phosporus precipitated as Zirconium phosphate. Counts per minute per gram of dry tissue were recorded for both phloem and xylem in each sample, and these were converted to percent of radiophosphorus with the amount on the immersion side of the lesion considered to be 100 percent.

Results

In the tests of downward movement of the P-32 using immersed needles, no significant statistical difference could be found between inoculated and control trees. The branch lesions had no appreciable effect upon the movement of P-32 down the branch, (Table 1).

Upward movement of P-32 through excised branch ends was also essentially the same in inoculated and control trees. There was no significant statistical difference in P-32 accumulation above lesions as compared with punctured areas. Tests for radioactivity in the lesion areas showed virtually none in the phloem but there was considerable activity in the xylem, indicating that movement was occurring in the latter. When P-32 was introduced by root absorption into trees with stem lesions to test upward movement beyond the lesion areas, there was still no

Table 1. Effect of Leptographium lesions in P-32 accumulation in stem, branch and root tissues of western white pine.

No. of trees	Part	Treatment	Immersion in P-32		Average percentage accumulation with standard error of the mean			
			Part	Average days	Above lesion		Below lesion	
					Xylem	Phloem	Xylem	Phloem
4	Branch	Inoculated	Needles	19	100	100	55 ± 7.9	81 ± 10.5
2	Branch	Control	Needles	17	100	100	37 ± 27.5	51 ± 41.5
2	Branch	Inoculated	Cut ends	3		246 ± 12.5		100
2	Branch	Control	Cut ends	3		288 ± 60.5		100
5	Stem	Inoculated	Roots	14	51 ± 13.5	54 ± 9.8	100	100
2	Stem	Control	Roots	14	87 ± 3.5	85 ± 10	100	100
4	Root	Inoculated	Roots	17	3.5 ± 2.0	5.2 ± 1.4	100	100
3	Root	Control	Roots	17	435 ± 327	465 ± 400	100	100

Table 2. Effect of Leptographium root lesions on P-32 accumulation in western white pine foliage.

No. of trees	Part	Treatment	Immersion in P-32		Average CPM per Gm. dry tissue
			Part	Average days	
2	Root	Inoculated	Roots	21	76 ± 21
2	Root	Control	Roots	21	3,880 ± 2,215
2	Root	Inoculated	Roots	13	1,912 ± 1,760
2	Root	Control	Roots	13	12,420 ± 6,800

significant difference between inoculated and control trees. However, the average amounts of P-32 above the lesion areas were smaller than the corresponding amounts in the control trees and it may be that a larger number of tests would confirm this difference statistically.

In testing upward movement of P-32 past root lesion areas, it was found that only 4 percent of the P-32 was contained in the areas above the lesion as compared with the amount below the lesion. In contrast, a much greater amount was found in corresponding parts of the control roots (Table 1). Unfortunately, the variation in the control trees was very high because of one individual in which activity above the simulated lesion was more than 1000 percent of that below the punctured area. The other two control trees had essentially the same amount of P-32 above and below the simulated lesions as might be expected. There seems no doubt that the difference between the inoculated and control roots here is significant although the large variance imposed by one tree makes it impossible to demonstrate statistically. In support of these findings, microscopic examination revealed that root lesions caused a greater deterioration of infected tissues than did branch or stem lesions. The obstruction of the P-32 in the root xylem seems likely to be due to the thrombotic action of pathological resin augmented by the presence of many fungus hyphae.

Since the phloem in all lesions was dead, shrunken, and resin-infiltrated, it is certain that the P-32 recovered beyond the lesions was transported through the xylem. It is postulated that the P-32 normally carried by the phloem was transported by the xylem, being conducted from the phloem to the xylem and back via the ray parenchyma.

The results of foliage analyses of inoculated and control trees are given in Table 2. Two groups of four trees, each having different immersion times, were counted and are listed separately. These data indicate that when P-32 is introduced through the roots, there is less activity in the inoculated as compared with the control trees. However, because of the small number of samples it is not possible to prove significance statistically between the treated and control trees.

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FOREST, WILDLIFE AND RANGE EXPERIMENT STATION, UNIVERSITY OF IDAHO

ALMOND SCAB

Joseph M. Ogawa, Carl W. Nichols, and Harley English[1]

Almond scab, a disease caused by a species of Cladosporium, has during the past few years caused some economic loss in the almond orchards of certain areas in California.

Almond scab was first reported in California by E. H. Smith (5) in 1924. She identified the causal agent as Cladosporium carpophilum Thuem., which was first reported on peach in Austria by Von Thümen in 1877. The first record of this organism on peach in the United States was in 1881 (4). On peach the disease is commonly known as peach scab. Serious financial losses from peach scab on fruits are reported from all of the important peach-producing districts of the central and eastern United States. The chief damage to almonds appears to be premature defoliation of the trees.

Symptoms

Almond scab (Cladosporium sp.) affects the fruits, shoots, and leaves of the host (Prunus amygdalus Batsch). The symptoms are similar to those described for peach scab (4) and pecan scab (1, 2).

Leaves: The first macroscopic evidence of infection appears on the lower surface of leaves as indistinct, somewhat circular, discolored areas which are barely visible to the naked eye. These infected areas enlarge and often coalesce, sometimes reach a diameter of 10 mm, and become visible from the upper leaf surface as chlorotic areas. The color of the lesion is at first greenish-yellow, later yellowish-brown, and finally brownish-black (Fig. 1). On petioles and midribs the color of the lesion is the same as on the leaf blade but the infected areas are more elongate. In most cases the affected tissue does not die before the leaf falls prematurely from the twig, but with leaves that remain on the tree until autumn necrosis of the infected regions is not uncommon. Premature defoliation resulting from leaf infection probably constitutes the most important economic phase of the disease. In 1954 symptoms on leaves appeared after those on shoots and fruits; the first leaf lesions were seen on June 18, over 3 months after the first lesions on shoots (March 2).

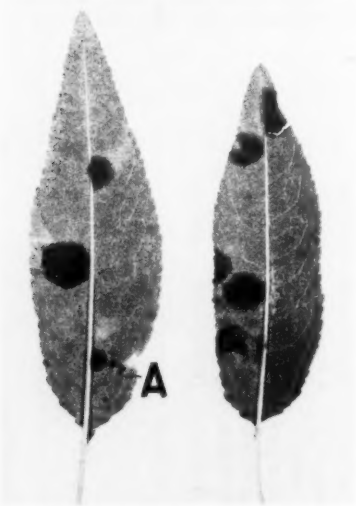

FIGURE 1. Severely affected leaves collected in the fall. (A) Diffuse type of lesion typical of those observed during the summer.

[1] The authors wish to express their appreciation to Ross M. Sanborn, farm advisor of Butte County, California, and Claudio Vergara, Ing. Agr., Depto. de Investigaciones Agricolas, Santiago, Chile.

FIGURE 2. Left -- Scab lesions on almond shoots. Right -- Enlarged view of scab lesion with marginal sporulation (A) and lesion caused by Coryneum beijerinckii (B).

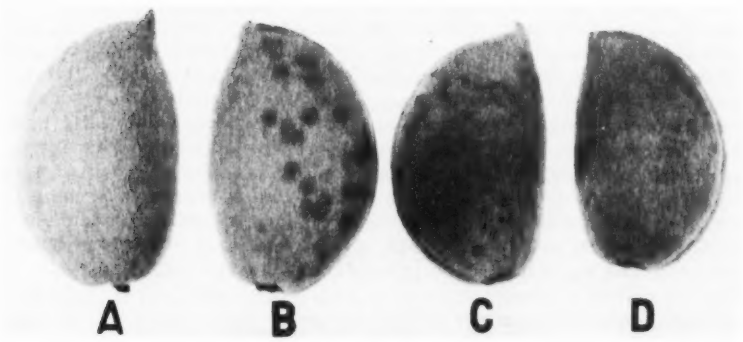

FIGURE 3. Almond fruits showing various degrees of scab infection. (A) Healthy fruit. (B-D) Scattered to coalesced lesions.

Shoots: The young tender shoots appear to be more susceptible to infection than older ones. The lesions on young shoots appeared as indistinct water-soaked areas. The presence of the fungus in these areas was demonstrated by isolations. The circular to oblong infected areas turned greenish-yellow, then brown, and later showed distinct dark-colored sporulation of the fungus along the margins (Fig. 2). In the fall, the typical lesion has a dark center surrounded by a light-colored ring and a blackish-brown area on the periphery. It is in these lesions that the organism overwinters. In the following spring it resumes growth from the margins of these old infected areas and sporulates. In 1954 no spores could be found on January 15 but by March 2 they were being produced in abundance on the advancing, water-soaked margins of the 1953 lesions. At the same time, other small water-soaked lesions became visible. Girdling of the shoots by the lesions was not observed and seems unlikely to occur because the lesions are very superficial.

Fruits: Indistinct, circular, olivaceous areas represent the first macroscopic symptoms on the young fruit. The spots, which at first are quite small, enlarge and coalesce to form large, irregular, greyish-black blotches which often cover half of the fruit surface (Fig. 3). Infection appears to be principally restricted to the upper surface of the fruit as it hangs on the tree. Susceptibility of the nut hull, however, does not appear to be restricted to any specific area. Restriction in the normal growth of the epidermis occasionally results in the formation of shallow cracks in the hull. Fruit infection during 1954 was visible in the early part of June. This was after lesions developed on shoots, but before symptoms were observed on leaves.

Distribution and Host Range

According to records of the Bureau of Plant Pathology of the California Department of Agriculture, scab-infected almond specimens were received from Butte County in the years 1940, 1942, 1953, and 1954. Scab-infected almond trees were also found on the University of California campus in Yolo County in 1942[2]. Examination of the University of California mycology herbarium showed collections of scabbed almond leaves from San Mateo County (April, 1950), Monterey County (July, 1942), and Napa County (September, 1946).

The host range of the peach scab organism (Cladosporium carpophilum), according to The Index of Plant Diseases in the United States (9), includes almond, apricot, European plum, nectarine, peach, and sour cherry. Prunus munsoniana Wight & Hedr., P. americana Marsh., and P. serrulata Lindl. are also listed as hosts. Records of the California Department of Agriculture, Bureau of Plant Pathology, reveal that the fungus also was found on a specimen of Catalina cherry (P. lyoni Sarg.) submitted from Los Angeles County in 1950.

R. E. Smith (6) first reported C. carpophilum in California in 1909. He found it on apricot in Santa Clara County. It was again reported (8) on this host in 1911. Keitt (4), in 1917, listed peach as a host in California. In a general account of stone-fruit diseases of California, Smith (7) lists peach, apricot, and nectarine as hosts. Records of the California Department of Agriculture show that scab-infected nectarines were received from Los Angeles County in 1923, scab-infected peaches from Ventura County in 1933, and scab-infected prunes from Sonoma County in 1941. Harris (3) also reported the disease on prunes in Sonoma County in 1941. According to records of the California Department of Agriculture scab occurred on plums and prunes in Santa Clara County in 1946 and 1949, Alameda County in 1947, and San Benito County in 1945. It also occurred again on prunes in Sonoma County in 1953.

Survey of the Disease in 1954

In 1954, experiments were initiated to develop a spray program for controlling almond scab. The fact that peach and other stone fruits growing near heavily infected almond trees in the experimental orchards did not show the disease raised the question as to the identity of the fungus on almond.

A preliminary survey of the major almond growing sections of the Sacramento Valley was made in the fall of 1954. The purposes were to determine: 1) the geographic distribution of the almond scab disease, 2) the host range of the causal fungus, 3) the severity of the disease on different varieties of almond, and 4) the orchard conditions under which the most severe symptoms occurred on almonds. Specimens of the disease were obtained from several different areas for later study of the fungus.

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[2] Wilson, E. E. Personal communication - 1954.

The survey was started in the orchards near Chico in Butte County, where the disease was known to occur, and extended in all directions from that city. The orchards selected were usually 1 to 2 miles apart. Only spot checks were made in each orchard visited. The distribution of the almond scab disease by counties is shown in Table 1.

Table 1. The occurrence of almond scab in the counties of the Sacramento Valley -- 1954.

County	Number of properties	
	Inspected	Infested
Butte	21	17
Colusa	7	1
Contra Costa	12	0
Glenn	9	5
Sacramento	3	2
Solano	8	0
Sutter	17	8
Tehama	9	5
Yolo	10	1
Yuba	9	1

Whenever other stone-fruit trees were found in or adjacent to scab-infected almond orchards, the trees were examined closely to determine if scab symptoms were present. In some cases isolations were attempted from suspected scab lesions. Apricots were examined on 7 properties in 2 counties; cherries on 7 properties in 1 county; nectarines on 4 properties in 1 county; peaches on 12 properties in 2 counties; and plums on 9 properties in 3 counties. No definite scab symptoms were observed on any stone-fruit trees other than almonds, and in no case was the scab organism isolated from such hosts.

During the survey the following varieties of almond were examined: Drake, I. X. L., Jordanolo, Ne Plus Ultra, Nonpareil, Peerless, and the variety the farmer called "Smith I. X. L." Symptoms of scab were found on all these varieties; they were most severe on Ne Plus Ultra and "Smith I. X. L." In some instances the Drake variety was severely infected. In only one orchard was the disease found on the Jordanolo variety and here the symptoms were mild compared to those on the other varieties in the same orchard.

The most severe scab infection usually occurred in trees situated in the low-lying areas of diseased orchards. The most severely infested orchards had a history of many irrigations per year, while many of the scab-free orchards were dry-land farmed or were irrigated only one to three times per year.

Summary

The scab disease of almonds, which occurs in the Sacramento Valley of California, is caused by a species of Cladosporium. The symptoms and signs on almond appear very similar to those described for peach scab and pecan scab.

The disease occurs on leaves, shoots, and fruits. Damage on fruits and shoots appears to be negligible. Leaf infection, which causes premature defoliation, causes the most damage.

Infected areas first appear as minute discolored spots. Later, circular greenish-yellow areas form which may coalesce and produce brown to greyish-black lesions. The fungus overwinters on the twig lesions and on infected nuts which hang on the tree. During the 1954 growing season, symptoms were first seen in the spring on twigs, then on fruits, and finally in the summer on the leaves.

A review of the pertinent literature shows that Cladosporium carpophilum Thuem. has been reported in California on almond, apricot, peach, cherry, nectarine, prune, and plum. However, a recent survey indicates that apricot, cherry, nectarine, peach, plum, and prune trees grown in or near almond scab-infested orchards were free of the disease. In a survey of almond orchards on 105 properties in 10 counties in the Sacramento Valley of California, almond

scab was present on 40 of the properties in 8 counties. The disease occurred on all almond varieties encountered, but appeared to be most severe on Ne Plus Ultra and "Smith I. X. L." The disease was more severe in the lower and wetter portions of an infested orchard where more humid conditions would be expected.

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SUSCEPTIBILITY OF AVOCADOS TO DEMATOPHORA ROOT ROT

Robert D. Raabe and George A. Zentmyer[1]

Dematophora root rot, resulting from infection by the Dematophora stage of Rosellinia necatrix (Hartig) Berl. (1) has been reported as occurring in 15 counties of California, including San Bernardino, Orange, and Riverside in southern California (2). The fungus, however, appears restricted in distribution in these counties and has never been found occurring naturally on the avocado, Persea americana Mill. Because of the continuing use of new land for avocados, greenhouse tests were planned to determine if this plant is susceptible to attack by the fungus.

Twenty-five seedlings each of Topa Topa and Mexicola varieties, representing the Mexican rootstocks, and of Anaheim and Dickinson varieties, representing the Guatemalan rootstocks, were started by planting the seeds in flats of chloropicrin-fumigated soil. As soon as seeds had germinated, the seedlings were potted in 4-inch pots. After they had become established, they were moved into 6-inch pots at which time 20 plants of each variety were inoculated.

The inoculum was prepared by growing the fungus on moistened wheat which had been sterilized by autoclaving. The inoculum was placed in the soil of the 6-inch pots as the plants were moved into them. The balls of soil surrounding the roots of the plants were disturbed as little as possible while moving to avoid root injury. The plants were maintained in a greenhouse for the duration of the experiment.

Within 3 weeks of inoculation, the infected plants began wilting as shown in Figure 1. Within 5 weeks, all inoculated plants were dead. Upon examination, the roots and cotyledons were found to be permeated by the hyphae of the fungus. Small, indefinte white plaques, similar to those of Armillaria mellea but not nearly so well developed, were found in the bark and cortex of the infected roots and throughout the fleshy cotyledons. Typically, the fungus grew out into the soil around the infected roots when the soil moisture content was high (Figure 2).

FIGURE 1. At right avocado seedling 3 weeks after inoculation with Dematophora necatrix. Plant at left is a check.

In view of the extreme susceptibility of the rootstocks tested and because of the lack of an effective eradicant fungicide, land with a known history of Dematophora should be avoided when planning new avocado orchards.

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FIGURE 2. Below-ground portion of avocado seedling infected with Dematophora necatrix.

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METHODS OF INCREASING THE EFFICACY OF SOIL FUMIGATION IN EXPERIMENTAL FIELDS[1]

C. E. Dallimore

Summary

Eradication of nematodes in the top 2 or 3 inches of soil can be obtained by plowing 5 or 6 days after applying the fumigant if the top layer of soil is pushed into the plow furrow ahead of the overturning soil. This is done by means of a scraper blade attached to the cultivator tool bar of the tractor. Sealing of the soil can be done in the same operation as the fumigation by attaching a spike-tooth harrow and chain drag to a tractor-mounted plow. Contamination of fumigated plots is avoided by using equipment that can be raised from the soil at the end of plots, placing definite borders such as rows of grass between plots, fumigating headlands and border rows, and between plots thoroughly removing all soil on implements by use of a steam cleaner.

Soil fumigation for the control of nematodes and other soil fauna is a well established practice. The factors affecting fumigation have recently been discussed by several workers (1, 6, 8, 12, 16). Immediately after applying the fumigant, whether with chisel or plow-sole applicators, the surface must be thoroughly worked, pulverizing all clods and removing large air spaces to prevent escape of the gases. Spike-tooth harrows, disk-harrows, land rollers, drags or floats alone or in various combinations have been used to effect this seal (2, 11, 17, 19). Care must be taken, however, to prevent carrying of soil from non-fumigated to fumigated plots when using such equipment in experimental fields (5).

In the top 2 inches of soil, which is usually dry, the nematodes are reported not to be killed even when the fumigants are applied according to rather specific recommendations (3, 4, 9, 13, 14, 15, 16, 18, 19). A complete kill is not always obtained even when a water seal is used (7). Diffusion of the gases near the surface is apparently so rapid that lethal concentrations are not realized in this region (16, 18, 19). The length of time the gas is retained is affected by the depth of placement, according to Schmidt (18), and if the fumigant is placed too deep a lethal concentration of gas is not accumulated near the surface. He also reports that diurnal fluctuations of atmospheric temperatures and drying of the surface soil definitely influences the mortality near the surface. To obtain a more thorough kill, Chitwood (4) made split applications of the fumigant, turning the soil at the time of the second fumigation and decided this method was better "probably due to the death of nematodes in surface soil." A similar use of split applications of ethylene dibromide has given very good results in the control and eradication of the potato rot nematode, Ditylenchus destructor Thorne, in Idaho (unpublished results). The method used for assuring that the top layer of soil will be placed at a depth where lethal concentrations of fumigating gases are accumulated has been responsible for the good results obtained.

The method used along with a method for rapidly sealing the soil when making plow-sole applications of fumigants is herein described. Suggestions for avoiding the scattering of soil from non-fumigated plots to fumigated areas are made. A few precautions to take when handling fumigants are given.

Fumigation of the Top Layer of Soil: Eradication can be achieved only when all parts of the soil containing nematodes receive a lethal concentration of fumigant. The top 2 or 3 inches of soil must then be placed at depths where there are such concentrations of gas. To accomplish this, a scraper is mounted on the tractor tool bar which pushes the top layer of soil into the plow furrow ahead of the overturning soil[2]. Thus it is buried in the bottom of the furrow rather than being distributed throughout the profile of the furrow slice as ordinarily occurs with the moldboard-plow.

The scraper was made of 1/4-inch sheet iron with shanks of 1-inch round iron near each

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[1] Published with the approval of the Director of the Idaho Agricultural Experiment Station as Research Paper No. 392.

[2] John L. Toevs, formerly superintendent, University of Idaho, Branch Experiment Station, Aberdeen, Idaho suggested the scraper, and with Gerald Thorne, Senior Nematologist, U. S. Department of Agriculture, placed this idea into use. It has been developed and perfected further by the author.

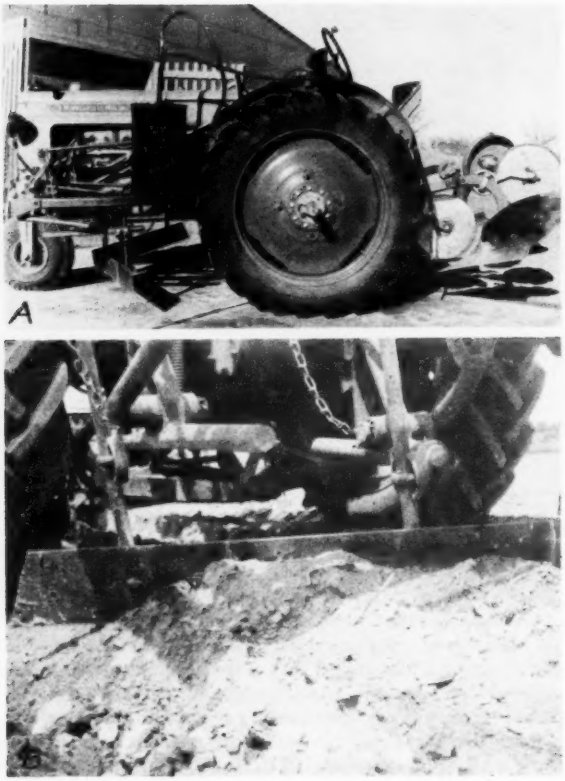


FIGURE 1. A: Tractor equipped for plow sole fumigation with scrapers that push the top dry soil into the furrow in front of the plow. The scraper is raised and lowered, each side operating independently, as the plow is raised or lowered, B: View of the scraper in operation.

end. By mounting it on the cultivator tool bar, the scraper was raised and lowered, each side independently, as needed. It was first used on a tractor pulling a trail type one bottom two-way plow, but a tractor mounted plow made a more compact unit as shown in Figure 1.

Potato tubers produced on land fumigated with ethylene dibromide at the rate of 90 pounds actual ethylene dibromide per acre were free of Ditylenchus destructor infection when the top soil was turned under after applying the fumigant, but infected tubers were found where the top soil was not turned under. The fumigant was applied 8 inches deep with a trailer type injector. The soil was turned over 5 days after application, using the scraper and trail type plow mentioned above. The reserve of gas in the soil was sufficient to fumigate the buried top soil without the addition of more fumigant. Similar results have been secured by applying 3/4 the amount of fumigant with chisel or plow-sole applicator and the remainder 5 or 6 days later, to supplement the reserve of gas, when turning under the top layer of soil using the scraper and plow-sole fumigator shown in Figure 1.

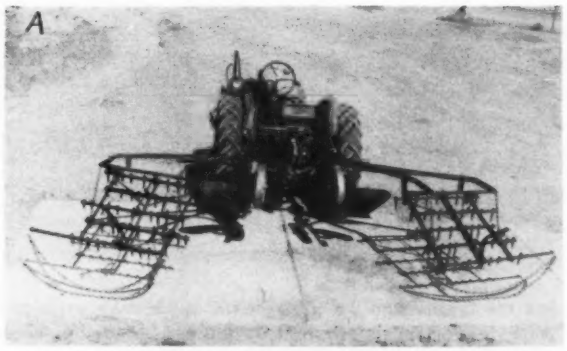
Lear, et al. (9), using a similar scraper attachment, found that it did not appear to increase the efficiency of fumigation for control of the golden nematode of potato, Heterodera rostochiensis Wollenweber. They waited, however, 11 days between time of application and the turning of the soil, at which time there apparently was not a sufficient reserve of gas left in the soil to kill all the cysts that were turned under.

Sealing the Soil Surface after Fumigation: The sooner the soil can be sealed to prevent escape of the gas the more effective the fumigation should be. By attaching a spike-tooth harrow to the plow so that plowing and harrowing can be done as one operation there is no lapse of time in which large amounts of the gas can escape before sealing.

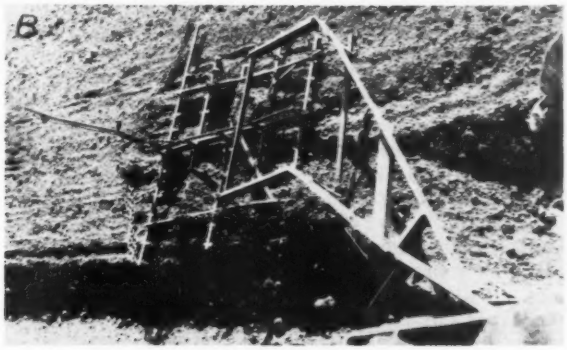
By means of an offset "A" frame, a section of spike-tooth harrow was attached to the beam of the tractor-mounted plow so that the harrow was raised and lowered with the plow. The apex of the "A" frame was bolted to a piece of channel iron welded on the plow beam. A brace from

FIGURE 2. Mounting of spike-tooth harrow on tractor-mounted plow for sealing of soil when making plow-sole applications of a soil fumigant.

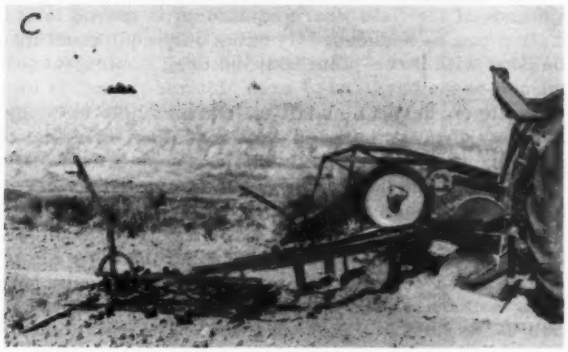
A: View looking down on tractor showing the harrows in carrying position.



B: Frame used in supporting and drawing harrow.



C: Side view of harrow support.



D: Overall view of scraper and harrow in position for plow-sole fumigation.

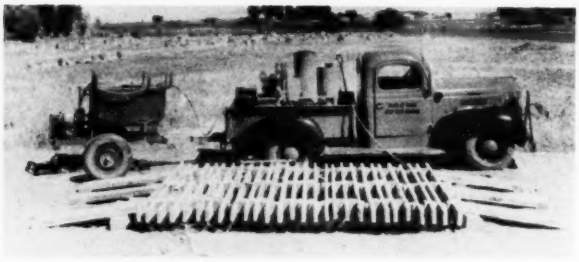


FIGURE 3. Gasoline engine driven steam cleaner, spray tank for water source, and wash rack used in steam cleaning machinery and implements between plots.

between the frame and the plow beam at another point provided additional support. The legs of the "A" extended to approximately the center of the sides of the harrow. Attachment of the harrow to the "A" frame was by chains to each corner. The harrow was pulled from a draw bar on the "A" frame to which it was attached by chains. When in use the harrow had free floating action and did an excellent job of harrowing. Four views of the equipment are shown in Figure 2. The harrow teeth marks were removed by two unequal lengths of log chain dragged behind the harrow. The last bar of the harrow was extended to the outside for a point of chain attachment so that the chain would be on the ground at the outer edge of the harrow. The harrow section covered more than two plow furrow slices so the ground was double harrowed, leaving the surface well pulverized.

Hansen and Nex (8) and McBeth (11) have pointed out that compaction of the soil reduces porosity, which in turn decreases the rate of dispersion of the gas or may even stop it entirely. The method of sealing described here avoids compaction as occurs by the tractor wheels when it is done as a separate operation.

To Avoid Contaminating Fumigated Plots: Care must be taken in experimental work to avoid contaminating fumigated plots with soil from non-fumigated areas. By fumigating the headlands at both ends of the field where equipment is moved to reach the plots the opportunities for contamination can be reduced. By using only equipment that can be lifted off the ground, such as can be done with three-point hook-up drag implements, the turning space of the machinery can be reduced to the headland of each plot and no soil is moved from plot to plot.

Definite borders which act as barriers help in keeping equipment within the confines of a plot. A row of grass between plots makes an excellent border where the same plots are to be used for several years. Slow growing bunch grasses are preferable to rapid growing sod types. Before seeding, the border should be fumigated so that it will not be a source of reinfestation. Since cultivation equipment and irrigation water are means of spreading nematodes, soil fumigation plots should be the length of the irrigation and cultivation run.

All soil clinging to implements should be removed between plots to eliminate a source of reinfestation. A portable steam cleaner, gasoline driven, has been found to be very effective in removing soil from even the most inaccessible places on farm machinery. The steam cleaner is taken to the field in a pick-up truck. The water supply is carried in a trailer tank with a gasoline engine driven pump. Mud is avoided by placing the equipment to be cleaned on a wooden wash rack constructed of 2 x 8 inch lumber placed on edge, spaced approximately 3 inches apart and set on three stringers of 6 x 6 inch timber. Planks of 3 x 12 inch lumber are used as runners for ascending the rack. The 2 x 8 inch lumber is bolted together in sections that a man can lift and place in the truck when these are to be moved. The equipment for field cleaning is shown in Figure 3.

Precautions in Handling Fumigants: Among the precautions usually given when handling fumigants is removal of clothing on which any fumigant is spilled in order to avoid serious burns. By wearing rubber overshoes and a rubber apron while transferring fumigants, the clothing can be protected from most spillage. Soap and water should be available at all times and the hands thoroughly washed immediately after handling fumigants.

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NOTES ON SPOT ANTHRACNOSES AND RELATED SUBJECTS
VI. SOME NEW DISTRIBUTION RECORDS[1]

Anna E. Jenkins[2]

Several specimens that establish additional distribution for various species of Elsinoë and Sphaceloma are listed herein.

The assistance of Mathilde Bensaude Gotz, who arranged excursions for me in Portugal in the summer of 1954, is gratefully acknowledged. I am also indebted to G. Morel for the specimen from Spain, to the Missouri Botanical Garden for permission to examine its herbarium collection of Virginia creeper, and to A. A. Bitancourt for critical reading of the manuscript of this article.

ELSINOË MATTIROLIANUM Arn. & Bitanc. (1, p. 320). Madrone anthracnose.
On Arbutus unedo.

Portugal, Amarante, August 11, 1954, A.E.J. From a landscape planting on the grounds of the National Forest Nursery. Infection was comparatively slight. Several wild plants of this native European shrub in the vicinity of Leiria were not affected.

Spain, locality not given, 1950, coll. & comm. G. Morel.

Previous European records are from Germany and Italy (1, 3).

ELSINOË PARTHENOCISSI Jenkins & Bitanc. (5, p. 424). Virginia creeper anthracnose.
On Parthenocissus quinquefolia (Ampelopsis quinquefolia).

Mexico, Jacala, July 9, 1939, V. H. Chase. Label: "Plants of Mexico 7376, July 9, 1939 . . . Mountain side, alt. 5000 ft. State of Hidalgo, Municipality Jacala. Mexican Biol. Exped." (See 2). In Missouri Bot. Gard. 1172254.

United States, Florida, ?July 1891, ?A. W. Chapman. Label: "Ampelopsis quinquefolia, Florida." Herbarium sheet stamped "Dr. A. W. Chapman Herb., purchased 1899." In Missouri Bot. Gard. 785791. This undated specimen from "Florida" in the Chapman Herbarium in the Missouri Botanical Garden shows Elsinoë leaf spotting noticeably like that on a specimen from Apalachicola, Florida, dated July 1891, in the Chapman Herbarium acquired by the United States National Museum (5, p. 424, 427), and it is probable that the two specimens are part of the same collection.

United States, Pennsylvania, August 14, 1882. Label: "Ampelopsis quinquefolia, American Ivy, Goodman's Forge, Pa. 8-14-82." In Missouri Bot. Gard.

On Parthenocissus quinquefolia var. saint-paulii (Ampelopsis saint-paulii).

United States, Missouri, June 20, 1937, J. A. Steyermark. Label: ". . . wooded slopes along King's River, south of Prentiss Ford, . . . 4 1/2 mi. southwest of Viola, in Barry Co. No. 22537." In Missouri Bot. Gard. 1147138.

These four phanerogamic herbarium specimens reveal the presence of E. parthenocissi on Virginia creeper in widely separated localities. Presumably the Florida and Pennsylvania specimens are from wild plants, as the other two evidently are. The Pennsylvania specimen is practically 10 years older than the one from Apalachicola, Florida, and is so far the earliest known record of E. parthenocissi. This is the most abundantly infected of the four specimens. It is interesting to note that the variety saint-paulii, used in horticulture, is susceptible.

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[1]A contribution under the Technical Assistance Program operating in Brazil, under the joint administration of the Brazilian and United States Governments.

[2]Mycologist, Foreign Operations Administration, assigned to the Technical Assistance Program in Brazil.

SPHACELOMA ROSARUM (Pass.) Jenkins (4, p. 330). Rose anthracnose. On Rosa spp. (cult.)

Portugal, Amarante, vicinity of Leiria, and Vila Vicosa, August 9-11, 1954. There is an earlier Portuguese record, from Porto Alegre (4, p. 325).

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FOREIGN PLANT DISEASES INTERCEPTED IN QUARANTINE INSPECTION

Clarence M. Locke and Alice J. Watson

In the following paragraphs is information on recent plant disease interceptions of importance taken from plant material imported by the U. S. Department of Agriculture through the Washington Inspection House. The data offered may be of interest to those pathologists in this country who are interested in the movement and distribution of plant diseases from one part of the world to another.

A shipment of Hordeum sp. from Turkey was found to be infected with Tilletia panicii Bubak & Ranojevic. This produces a dark reddish-brown, powdery spore mass in the ovaries. So far as known this disease does not occur in the United States. Turkey is a new country of origin and our first record of its occurrence there was the above interception made in 1952. In addition, it is also reported to occur in Wdadinvzi, Yugoslavia, on Hordeum vulgare L.; on H. distichon L. and H. hexastichon L. in Czechoslovakia; and on H. vulgare (H. tetrastichum Stokes) in Bulgaria, Yugoslavia, and Japan, a total of five countries, including Turkey. Since the above host of this disease is grown in the temperate regions of both hemispheres it is possible that it could become established in this country.

Puccinia aeluropi Ricker was found on the stem and leaves of Aeluropus sp. from Turkey. From available information this disease apparently is not yet established in this country. While Turkey represents a new country of origin, our first record there being 1952, a more recent record, 1954, and another new country of origin is Afghanistan, the source of a shipment of seed of Aeluropus littoralis Parl contaminated with infected portions of plant stems. In addition, it is also reported to occur in China on A. littoralis and in northwest India on A. macrostachyus Hack.

A shipment of Triticum aestivum L. imported from Afghanistan was found to be infected with Neovossia indica (Mitra) Mundkur. It has been reported that this is not yet established in North America. Besides Afghanistan, a new country of origin, it is reported to occur in only one other country, India, where it causes up to 20 percent damage in wheat in the hot lowlands. Cool damp weather favors infection. Only a few grains in each head are attacked, the infection partially or completely destroying affected kernels, which are not swollen. This smut, according to Mundkur, usually destroys only part of the kernel while other species of Tilletia destroy the entire grain. The pathogen is carried in the seed tissues.

Puccinia longicornis Pat. & Har. was found on a shipment of bamboo imported from Japan. This rust attacks the leaves of some species, causing formation of yellow-brown to dark-brown pustules. In addition to Japan, the rust is also reported to occur in Ceylon, China, Indo-China, and the Philippines. Bamboos are largely Asian in origin. Several introduced genera with about 70 species are now grown in the United States, some of which are hardy as far north as Philadelphia. In addition to the introduced plants there are a few native Arundinarias. As a group these bamboos are of considerable economic importance and they have long been protected against disease introduction by a strict prohibitory quarantine intended to prevent the arrival and dissemination of such diseases as this rust, P. longicornis.

PLANT QUARANTINE BRANCH, AGRICULTURAL RESEARCH SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE

UNUSUAL RECORDS AND OTHER BRIEF NOTES

CLITOCYBE TABESCENS ON CAMELLIA

By A. G. Plakidas

Two large Camellia japonica plants, about 10 years old, growing in a private garden in Baton Rouge, Louisiana, wilted and died rather suddenly. One of these plants was dug by Mr. Cancienne, inspector for the State Department of Agriculture, and brought to this laboratory for diagnosis. The trunk was completely girdled from the crown to about 6 inches above the ground line. Extensive white mycelial plaques occurred underneath the dead bark both on the larger roots and on the trunk (Fig. 1). Clitocybe tabescens was isolated from the roots and the

FIGURE 1. Camellia killed by Clitocybe tabescens. Note the white mycelial plaques on the trunk and large roots.

trunk. It is believed that this is the first report of the camellia being a host of this fungus.

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CAMELLIA PETAL BLIGHT IN LOUISIANA IN 1955

By A. G. Plakidas

Camellia petal blight (Sclerotinia camelliae) was found during the 1955 blooming season in properties in New Orleans both in the gardens in which the disease was first found in 1951 and in several additional properties surrounding the original infested area. It has spread in a northeasterly direction for a distance of approximately 2 miles. It was also found in a garden about 3 miles from the original infested area, but it is believed that it was brought to this garden by balled plants taken from the infested area and not by natural spread by wind-borne ascospores.

In Shreveport, where, following the vigorous clean-up campaign of the Shreveport Men's Camellia Club, no blight was found in 1953 or 1954, the blight was found again this year on two properties. No blight was found this year in the Monroe area.

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ALFALFA DISEASE SURVEY IN VIRGINIA

By S. B. Fenne

On April 20, 21 and 26 a group of plant pathologists, agronomists and entomologists visited the counties of Halifax, Pittsylvania, Mecklenberg, Prince Edward, Bedford, Roanoke and Montgomery for the purpose of observing alfalfa.

Stem nematode (Ditylenchus dipsaci) was found in each of the following counties: Halifax, Pittsylvania and Prince Edward. The infestation in Prince Edward County is a new location although the disease was found in another part of the same county two years ago. The infestation in Halifax is the first known occurrence of stem nematode in that county.

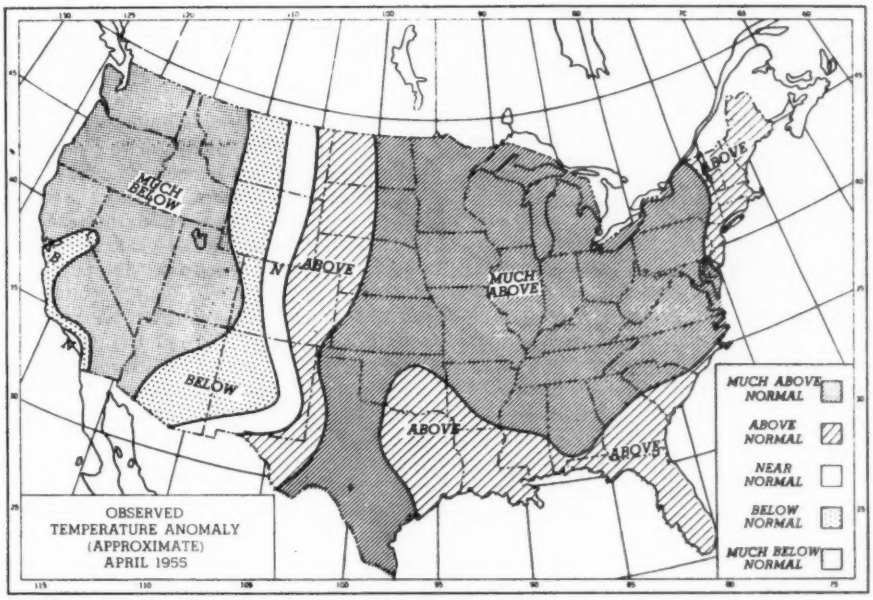
Blackstem (Ascochyta imperfecta) was severe in most alfalfa fields visited. A heavy infection was frequently found scattered on the leaves, and in many cases the stems were completely blackened.

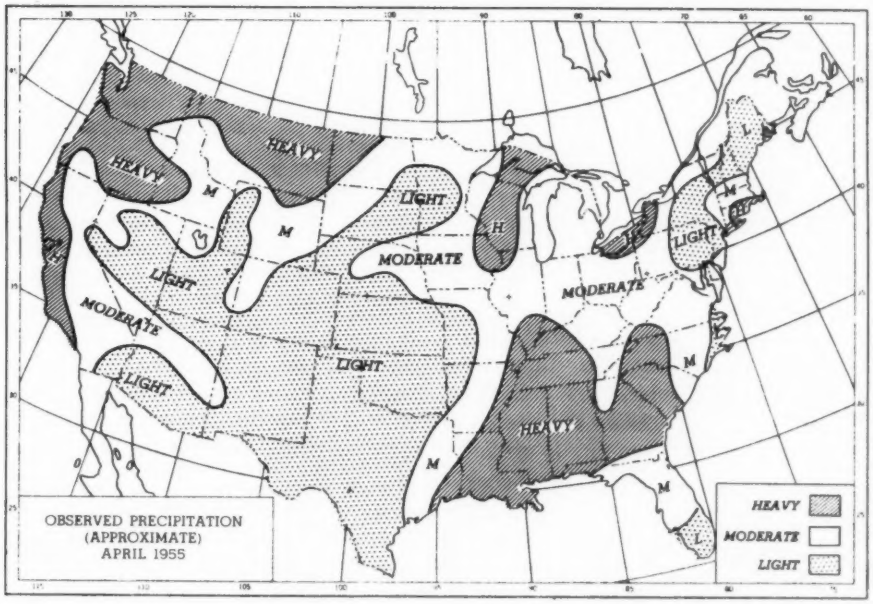
Stem and crown rot (Sclerotinia trifoliorum) was found on two farms in Halifax and Mecklenberg Counties. It is quite likely that this disease had been quite severe earlier in the year; however, at the present time stem rot is inactive.

In Montgomery County two fields were observed with a heavy infection of mosaic and three fields with considerable downy mildew (Peronospora trifoliorum).

Throughout the State many fields of alfalfa had been severely damaged by a combination of several factors. In late March severe freezes occured in most parts of the State and alfalfa, as well as other crops, was severely damaged. One field was observed where the top growth was completely killed and the plants appeared too weak to send up new shoots. This field had been top dressed with a 5-10-5 fertilizer mixture before the freeze. It was thought that the nitrogen fertilization had stimulated succulent growth which was more subject to freeze injury. Aphids were very numerous and in many fields had caused severe damage. The combination of freeze, aphids and blackstem had completely ruined the crop in many fields and the alfalfa stands will, undoubtedly, be greatly reduced.

VIRGINIA POLYTECHNIC INSTITUTE EXTENSION SERVICE, BLACKSBURG





The terms used in the accompanying maps, which define the ranges of temperature and precipitation, are numerical class limits. These are based on a statistical analysis of past records through which is determined the normal frequency of occurrence of temperatures and precipitation at various times of the year for different locations. For temperature the classes above, below, and near normal are so defined that they each normally occur one-fourth of the time; much above and much below normal, one-eighth of the time. Precipitation is depicted in terms of light, moderate, and heavy, each class normally occurring one-third of the time and thereby having equal probability of occurrence. These maps graphically represent only the general trends and give the country's weather picture at a glance. For quantitative studies, where monthly mean temperatures and actual precipitation records are needed for a given time and place, other publications of the Weather Bureau should be consulted. P. R. M.

MANUSCRIPTS FOR THE PLANT DISEASE REPORTER

(See also PDR 35: 121-122; 36: 214, 494)

(1) GENERAL: The Reporter page measures 9 inches long with the heading or 8 3/4 inches for the text part, by 6 inches wide. The copy is typed on a larger page, 11 1/4 inches of text or 12 inches overall in length by 8 inches in width, and reduced 25 percent in the photographic process of reproduction. Illustrations or tables larger in either dimension will take a correspondingly greater reduction. Only one size of type is available for text, footnotes, or tables.

(2) MANUSCRIPTS should be the original ribbon copy, not carbons, clearly typed and double-spaced throughout, including tables, footnotes, and bibliographies. (Note -- only one copy is needed.) Footnotes should be typed at the bottom of the page.

(3) ABSTRACTS are requested for all except very short articles. (PDR 38: 316).

(4) CAUSES OF DISEASES should be named. For bacteria, fungi, nematodes, etc., give the Latin name of the organism; for viruses either or both the accepted common name of the virus or a Latin name if you prefer it and there is one; for non-parasitic diseases state the causal factor if it is known. If the cause of a disease has not been determined say so. (PDR 36: 494).

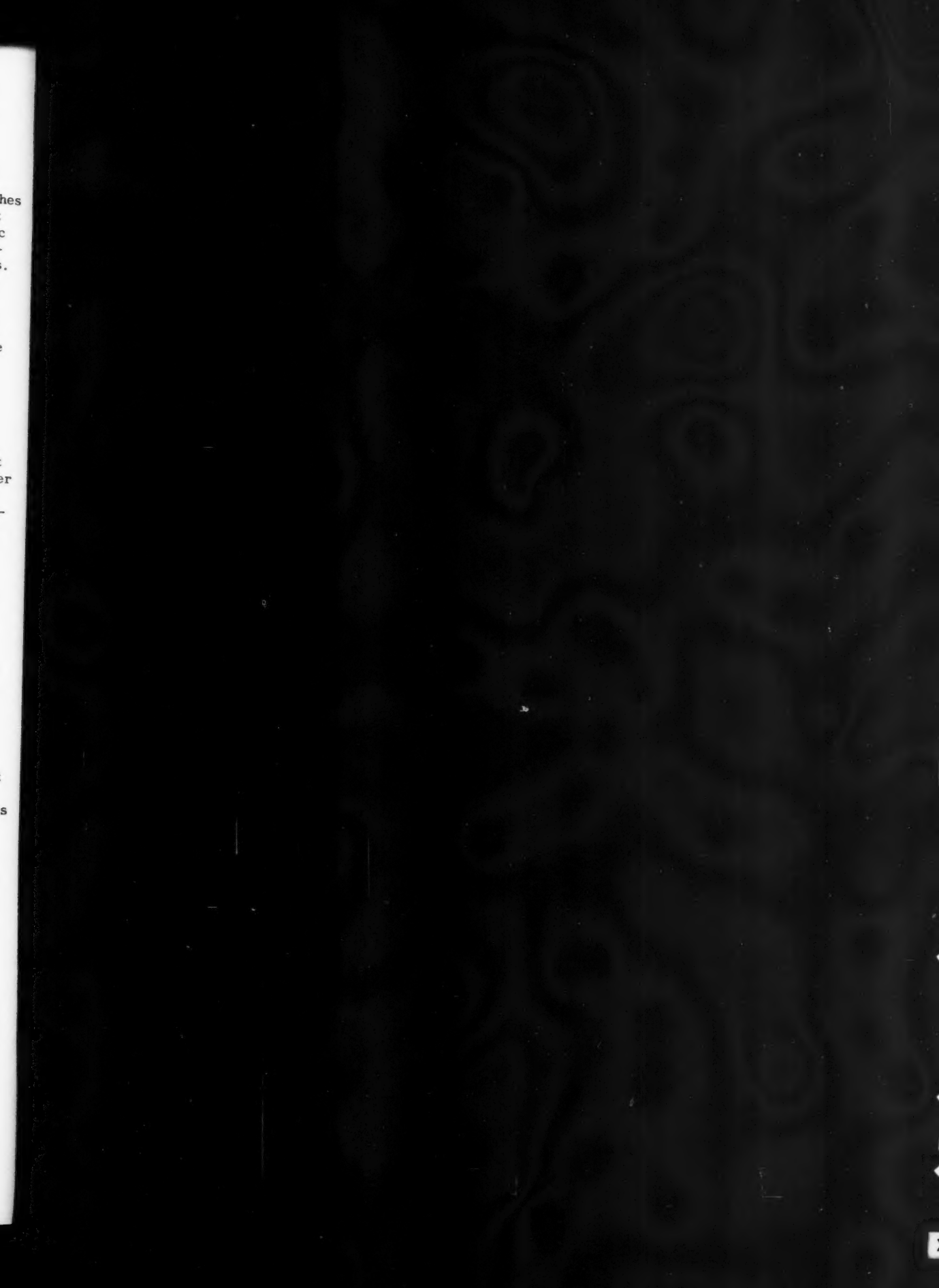
(5) LITERATURE REFERENCES should be given in alphabetical order and numbered for citation in the text. We follow the AIBS suggestion of placing the year of publication after the author's name. Please check your titles carefully since we cannot do it for you. Be sure that text citations and bibliography agree; that foreign-language references are correct; that number or month is cited for periodicals that are not paged consecutively throughout the volume.

(6) NAMES OF FUNGICIDES should be given according to the suggestions that will be published in Phytopathology before long, and later repeated in the Reporter. In the meantime see PDR 35: 122.

(7) ILLUSTRATIONS should be sent to us unmounted. To prevent mistakes, write figure numbers on the back, and mark the top of each print when necessary. A sketch can show a preferred arrangement but please keep in mind page size, shape, and standard reduction (see above under General), and remember that figure titles and legends are part of the page. Lettering should be clear and large enough to be legible after reducing. Drawings, maps, and graphs can be photographs or originals, but should be finished and ready for reproduction, not just sketches.

(8) TABLES should be carefully thought out with particular attention to the Reporter's limitations in reproduction. Make titles and headings definite and self-explanatory. Designate footnotes in tables with superscript lower-case letters. Be sure that text discussion agrees with the data in the table. Do not abbreviate names of crop varieties.

(9) REPRINTS cannot be supplied since there is no way in which we can be reimbursed. However,

(10) The MULTILITH PLATES from which reprints can be made will be sent if requested at the time the article is submitted. The press size of these plates used for the Reporter is designated as small -- maximum image 9 1/2 by 13 inches, maximum paper size 9 3/4 by 14 inches -- for Model 1250. Most of the Experiment Stations have this type of multilith machine.

(11) We are the official correspondents in the United States of the PLANT PROTECTION BULLETIN published monthly by the United Nations Food and Agriculture Organization. We would appreciate it if plant pathologists would send us suitable material from time to time for inclusion in our monthly summary reports. Please mark it clearly so that we will know it is intended for the Bulletin. (See PDR 36: 492; 37: 637) -- P. R. M.